
# SHIVAJI UNIVERSITY, KOLHAPUR

REVISED SYLLABUS AND STRUCTURE
FINAL YEAR (B.Tech.)

# PRODUCTION ENGINEERING

To be introduced from the academic year 2021-22

(i.e. from June 2021) onwards

**(Subject to the modifications will be made from time to time)**

**FOURTH YEAR PRODUCTION ENGINEERING – CBCS PATTERN**

| SEMESTER – VII | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sr. No | Course (Subject Title) | TEACHING SCHEME | | | | | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
| | | THEORY | | | TUTORIAL | | | PRACTICAL | | | THEORY | | | | | PRACTICAL | | | TERM WORK | | |
| | | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Hours | Mode | Marks | Total Marks | Min | Hours | Max | Min | Hours | Max | Min |
| 1 | PCC - PE401 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | As per BOS Guidelines | - | - | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 2 | PCC - PE402 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | | 25 | 10 | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 3 | PCC - PE403 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | | - | - | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 4 | PCC - PE404 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | | 25 | 10 | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 5 | PCE - PE405 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | | 25 | 10 | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 6 | SI - PE406 | - | - | - | - | - | - | 1 | 2 | 2 | | - | - | - | - | | - | - | - | 25 | 10 |
| 7 | PW - PE407 | - | - | - | - | - | - | 4 | 4 | 4 | | | | | | | 50 | 20 | 4 | 25 | 10 |
| | **TOTAL** | 15 | 15 | 15 | - | - | - | 10 | 16 | 16 | | - | - | 500 | - | | 125 | | - | 175 | |

| SEMESTER – VIII | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sr. No | Course (Subject Title) | TEACHING SCHEME | | | | | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
| | | THEORY | | | TUTORIAL | | | PRACTICAL | | | THEORY | | | | | PRACTICAL | | | TERM WORK | | | |
| | | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Hours | Mode | Marks | Total Marks | Min | Hours | Max | Min | Hours | Max | Min |
| 1 | PCC - PE408 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | As per BOS Guidelines | | | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 2 | PCC - PE409 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | | 25 | 10 | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 3 | PCC - PE410 | 3 | 3 | 3 | - | - | - | 2 | 4 | 4 | | CIE | 30 | 100 | 40 | | 25 | 10 | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 4 | PCE - PE411 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | | - | - | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 5 | PCE - PE412 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 40 | | - | - | 2 | 25 | 10 |
| | | | | | | | | | | | | ESE | 70 | | | | | | | | |
| 6 | PW - PE413 | - | - | - | - | - | - | 4 | 4 | 4 | | | | | | | 75 | 30 | 4 | 50 | 20 |
| | **TOTAL** | 15 | 15 | **15** | - | - | - | **10** | **16** | 16 | | - | - | **500** | - | | **125** | - | | 175 | |
| | | | | | | | | | | | | | | | | | | | | | |
| | **TOTAL** | **30** | **30** | **30** | - | - | - | **20** | **32** | **32** | | - | - | **1000** | | | **250** | - | | **350** | |

CIE- Continuous Internal
Evaluation ESE- End semester
Examination

| | |
|---|---|
| • Candidate contact hours per week:30 Hours (Minimum) | • Total Marks for B.E. SemVII&VIII:**1600** |
| • Theory/Tutorial Duration:60Minutes and Practical Duration:120Minutes | • Total Credits for B.E. Sem III &IV:**50** |
| • In theory examination there will be a passing based on separate head of passing for examination of CIE andESE. | |
| • There shall be separate passing for theory and practical (term work)courses. | |
| • Sem VII &SemVIII:- | |

**Note:**

1. Professional Core Course – Production Engineering (PCC-PE) arecompulsory.
2. Professional Core Electives - Production Engineering (PCE-PE) arecompulsory.
3. Summer Internship -Production Engineering (SI-PE) iscompulsory.
4. Project Work Production Engineering (PE-PE)iscompulsory.

## COURSE CODE AND DEFINITION

### Semester VII

| Sr. No. | Code No. | Subject | Credits |
|---|---|---|---|
| **1** | PCC-PE401 | Operation Research | **4** |
| **2** | PCC-PE402 | Mechatronic System | **4** |
| **3** | PCC-PE403 | Production and Operations Management | **4** |
| **4** | PCC-PE404 | Process Engineering | **4** |
| **5** | PCE-PE405 | Elective I | **4** |
| **6** | SI-PE406 | Industrial Training | **1** |
| **7** | PW-PE407 | Project Work Phase-1 | **4** |
| | | **Total** | **25** |

### Semester VIII

| Sr. No. | Code No. | Subject | Credits |
|---|---|---|---|
| **1** | PCC-PE408 | Costing and Cost Control | **4** |
| **2** | PCC-PE409 | Industrial Engineering | **4** |
| **3** | PCC-PE410 | Finite Element Analysis | **5** |
| **4** | PCE-PE411 | Elective II | **4** |
| **5** | PCE-PE412 | Elective III | **4** |
| **6** | PW-PE413 | Project Work Phase II | **4** |
| | | **Total** | **25** |

**Final Year B. Tech (Production Engineering) –Semester VII**

**OPERATION RESERACH**

**Course Code: PCC-PE401**

**Teaching Scheme:**
Lectures: 3 Hrs/Week
Practical:2Hrs./Week/Batch
Credits:4
Term Work: 25 Marks

**Examination Scheme:**
TheoryPaper: (2.5 Hrs)
ESE: 70 Marks
CIE: 30Marks

**Pre-requisites:**

**Course Objectives:**

1. To study a quantitive methods and techniques for effective decisions–making; model formulation and its applications those are used in solving problems.
2. Apply Various Models of Operation Research Such as Linear Programming Model,Assignment Model, Transportation Model, Network Model and Sequencing Model.

**Course Outcomes:** Students are able -

1. To understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type
2. Formulate and solve a wide variety of applications and problems that can be addressed using Operations Research techniques as Linear programming problems.
3. Formulate and solve a wide variety of applications and problems that can be addressed using Operations Research techniques as Transportation and Assignment problems.
4. Apply the various techniques of Project Management such as Network Model and Sequencing Model.

| | |
|---|---|
| **Unit-1: Introduction to O.R and Linear Programming:** Birth of O.R., Methodology, Scope and Limitations. Types of O.R. Models, Applications in Production Management, Use of computers in O.R, Linear Programming: Formulation, graphical method. | **[5]** |
| **Unit-2: Linear Programming Problems:** Simplex algorithm for maximization and minimization problems, duality theory and its use in economic interpretation and decision making. | **[6]** |
| **Unit-3:Transportation and Assignment Models:**Structure, Industrial and business applications<br><br>**a) Transportation problems:** Use of various methods for solving transportation problems,degeneracy and its solution. | **[7]** |

| | |
|---|---|
| **b) Assignment problems:** Solution of various types of problems, Traveling Salesman problem. | |
| **Unit-4:Sequencing and Replacement Analysis:**<br><br>**a) Sequencing:** Sequencing of n jobs and 2 and 3 machines, 2 jobs and m machines.<br><br>**b) Replacement Analysis:** With and without time value of money, single item and group replacement. | **[6]** |
| **Unit-5: Project Management:**<br><br>**Fundamentals of CPM / PERT networks:** CPM – construction of networks, critical path, forward and backward pass, floats & their significance, crashing for minimum cost and optimum and minimum duration, resource allocation and leveling.<br><br>**PERT –**Time Estimates, Construction of Networks, Probability of completing projects by givendate. | **[9]** |
| **Unit-6: Decision Theory and Network Techniques:**<br><br>**a) Decision Theory:** pay off and regret tables, decision rules, decisions under uncertainty and risk, decision tree.<br><br>**b) Network Techniques:** Shortest path model- Dijkstra's Algorithm, Floyd's Algorithm. | **[7]** |

## Term Work:

It shall comprise of the following numerical assignments .At least two assignments must be based on Case study. Use of computers is essential for at least two assignments

1. Formulation of LPP and Graphical Solution.
2. Assignment on Maximization / Minimization of L. P. Problems.
3. Assignment on Transportation / Assignment Problems.
4. Assignment on Replacement Analysis.
5. Assignment on Sequencing Problems.
6. Assignment on CPM/PERT Problems
7. Assignment on Decision Theory.
8. Assignment on Shortest Path Models

## Textbooks:

1. "Operations Research", J. K. Sharma, McMillan India Publication New Delhi,5th Edition
2. "Operations Research", Hira and Gupta, S.Chand and Co. New Delhi.
3. "Operation Research an Introduction", Hamdy A. Taha, Pearson,10th Edition

## Reference Books:


1. Quantitative Techniques in Management, 4/e - N.D. Vora. (TMH)
2. Introduction to O.R., 7/e (with CD) – Hillier & Lieberman (TMH)
3. Operations Research, 2/e – R. Panneerselvam (PHI)
4. Operations Research- Natarajan, A.M.; Balasubramani, P. &Tamilrasi A. (Pearson Education)
5. Operations Research – J.K. Sharma. (Mac Millan)
6. Operations Research – P. SankaraIyer (TMH- Sigma Series, 2008)
7. Operations Research – Principles & Practice - Ravindran, Phillips & Solberg (John Wily &Sons, Wiley India, 2006)
8. Introduction to Operations Research-Theory & Applications, - H.S. Kasana& K.D. Kumar,(Springer International Edition, 2005, Springer India)
9. Operations Research- Applications & Algorithms, 4/e, - Wayne L. Winston (CENGAGE Learning 2003)

**Final Year B. Tech (Production Engineering) –Semester VII**

# Mechatronics System

**Course Code: PCC-PE402**

**TeachingScheme:** **Examination Scheme:**

Lectures: 3 Hrs. / Week Theory Paper: (2.5 Hrs)

Practical: 2Hrs./Week/Batch ESE: 70 Marks

Credits:4 CIE: 30Marks

Term Work: 25 Marks

Oral Exam: 25 Marks.

**Pre-requisites:** Basicsknowledge of electrical & electronics is required**.**

**Course Objective:**

To understand working principle of necessary components required for Mechatronic Systems and their applications in system designing.

**Course Objective:**

The student shall demonstrate the knowledge of the working principles of necessary components required for Mechatronics Systems and their applications in system designing.

**UNIT-1: Control Systems**: Components of Mechatronics systems, Types of Control Systems, concept of transfer function, Modes of control on/off, P, PI, PD and PID, Adaptive control system, System modeling of mechanical, electrical, fluid systems, D.C. motor and generator; Types of standard inputs (signals), Time response specifications of first and second order systems **(6)**

**UNIT-2: Sensors, Transducers and Actuators**: Performance, terminology, characteristics, types, binary and analog; Contact and non-contact type switches and proximity sensors- inductive, capacitive, optical, pneumatic, potentiometric, thermal, incremental and absolute encoders, tacho generator; Applications in position, displacement, velocity, force, torque and temperature measurement; Actuators – working principle and applications: Variable frequency AC drives, Pulse width modulation and cycloconvertor for controlling AC frequency, Brushless DC servomotors, timing motors, torque motors, SCR (Silicon Controlled Rectifiers) motors, Stepper motors- types, specifications and control, relays and solenoids. **(10)**

**UNIT-3: Programmable Logic Controllers (PLC) and Supervisory Control And Data Acquisition (SCADA):**Structure, input/output units and input/output processing, programming, ladder diagrams, logic functions, latching, sequencing, timers, counters, jumps, analog input/output and applications, Concept of SCADA, its industrial significance and applications. **(6)**

**UNIT-4: Microcontroller:** Architecture and pin diagram of 8051 controller, Programming of microcontroller, selection of microcontroller for automation applications, interfacing**. (4)**

**UNIT-5: Signal Conditioning and Interfacing:** Signal conditioning processes, clock signal, voltage

divider, rectification, Operational Amplifiers: inverting and non-inverting, summing, integrating, differential, logarithmic, comparator; 555 timer, sample and hold, analog to digital and digital to analog converters, multiplexing and de-multiplexing, Interfacing input output ports, serial and parallel interfacing requirements, buffers, handshaking, polling and interrupts. **(6)**

**UNIT-6: MEMS**: Overview of MEMS and Microsystems, typical MEMS and Micro system products and applications. (i) Micro sensors and micro actuators: phototransistors, pressure sensors, thermal sensors, micro grippers, micro motors, micro valves, micro pumps (ii) Micro-manufacturing: bulk manufacturing, surface manufacturing, LIGA process. Case study of mechatronics systems in manufacturing and automation.**(6)**

## Term Work:

1. Fabrication of a simple Mechatronics working project by a group of 2-3 students, (A list of some sample projects is given further. One Project shall be carried out by each of the student groups and submitted as a part of term work.).**
2. Minimum two programs and their execution on PLC for logic, timer, counter and sequencing applications involving use of sensors for position, displacement and velocity.
3. Use OPAMP KITS to perform experiments (minimum two)
4. Interfacing of stepper motor with microcontroller/PLC for position, speed and direction control
5. One Exercise involving programming of microcontroller with interfacing of sensors for simple control applications like temperature control, pressure control, position control etc.
6. Simple MATLAB/SCILAB Programming exercises for control system (minimum two).
7. One assignments on SCADA applications for simple problems.
8. Industrial visit to study Mechatronic system application and submission of visit report.

****Note:**This project exercises shall include use of PLC, microcontroller, various sensors, Analog-todigital and Digital-to-analog conversion, simple electronic circuits etc. for Mechanical/Production Engineeringapplications.

The list given below is indicative only and other suitable projects may be undertaken.
List of Sample Projects:
Automatic door control (Open/Close), Water level control, Automatic Belt conveyor, Soft touch bi-directional motor control, Temperature sensor with analogue to digital output, Overheat control using heat sensor to operate cooling fan, Automatic railway gate control, Clap operated relays, Piece counters etc.

Note for Practical Examination: A batch of not more than two students shall perform any one exercise from 2, 3, 4 and 5 of above-mentioned list and show the results. This will be followed by oral examination.

## Reference Books:

1. Ogata – Modern Control Engineering (Pearson Education) ISBN 81-7808-579-8
2. Industrial Automation – David. W. Pessen (John Wiley & Sons) ISBN 9971- 51-054-5.
3. Automated Manufacturing Systems: Sensors, Actuators – S. Brain Morriss (McGraw Hill) ISBN 0-07-113999-0
4. Mechatronics 3/e - W. Bolton (Addison Wesley) ISBN 81-7758-284-4
5. Introduction to Mechatronics & Measurement System – David G. Alciatore& Michael B. Histand (TMH) ISBN 0-07-052908.

6. Mechatronics Principles, Concepts & Applications – N.P.Mahalik (TMH) ISBN 0-07- 0483744
7. Mechatronics – Dan Necsulescu (Pearson Education) ISBN 81-7808 -676 – X.
8. The 8051 Microcontroller: Architecture, Programming & Applications, 2/e – Kenneth J. Ayala (Penram International) ISBN – 81-900828-7
9. Computer Control of Manufacturing systems-YoramKoren (McGraw Hill) ISBN 0-07-066379-3
10. MEMS & Microsystems Design & Manufacture – Tai – Ran Hsu – TMH 0-07-048709.
11. MEMS – Mahalik, N.P. (TMH) ISBN :13 978-0-07-063445-9
12. CAD/CAM –Concepts & Applications, Channakesava R. Alavala (PHI)
13. Mechatronics, Singh, M.D,.& Joshi J.G. (EEE) (PHI) (2006- ISBN 81-203-2986-4.
14. Practical SCADA for industry, David Bailey, (Elsevier Publi.) ISBN 0-7506-5805-3.

**Final Year B. TECH (Production Engineering) –Semester VII**

# PRODUCTION AND OPERATIONS MANAGEMENT

**Course Code: PCC-PE403**

**Teaching Scheme:**
Lectures: 3 Hrs./ Week
Practical: 2Hrs./Week/Batch
Credits:4

**Examination Scheme:**
Theory Paper: (2.5 Hrs)
ESE: 70 Marks
CIE: 30 Marks
Term Work: 25 Marks

**Course Objectives:**
The course aims to:

1. Get acquainted with basic aspects of Productionmanagement
2. Study various important planning, organizing and controlling aspects of operations management
3. Study different operational issues in manufacturing and serviceorganizations.

**Course Outcomes:**
Upon successful completion of this course, the student will be able to

1. The students will have fair understanding of the role of Production / Operations Management played in businessprocesses.
2. Emphasis on both familiarization of various production processes and service systems and quantitative analysis of problems arising in the management ofoperations.

**Unit 1 Introduction toProductionManagement[07]**
Production types, Objectives and scope of Production Management(1), Production Planning and Control (PPC)- Definition and elements and activities of production planning and production control Relevance(2), Strategy formulation process(3), Order qualifiers and order winners(4), Strategic options for Operations- Product – Process Matrix(5), Product portfolio, Process technology(6), WCM practices(7)

**Unit 2 Product and Process Design [06]**
Determinants of process characteristics- Volume, Variety, Flow, Types of processes(1), Choice of Process, Equipment selection(2), Use of BEP in selection process- Product matrix(3). Estimation of Demand- Time series Analysis and causal forecasting techniques, Least square method, Moving average and exponential smoothing forecasting method(4) Role of Product Development in competitiveness(5), Product Life Cycle (PLC), Product Development Process.(6)

**Unit 3 Capacity and SchedulingofOperations:[07]**

Capacity- Definition, Measure of Capacity(1), Capacity strategies,Estimation of number of machines(2), Overcapacity and under capacity factors, Aggregate Planning, Aggregate Planning Strategies(3), Use of transportation model approach to aggregate planning Loading, scheduling and sequencing(4), Priority sequencing rules(5). Sequencing problems, n job 2 machines, n Job '3' machines(6). Forward and backward scheduling, Critical ratio scheduling, Production Control Activities(7)

**Unit 4 Supply Chain Management and AdvancedManufacturingTechniques:[08]**

Concept of supply chain and supply chain management(1), Manufacturing supply chain, SCM activities, Supply chain strategies, Managing supply chain, Measuring supply chainperformance(2),

JIT Philosophy, Origin and core logic of JIT, Elements of JIT(3), Kanban System- Design of Kanban containers(4), JIT.Implementation issues and performance(5), Lean Manufacturing-Pillars(6), features and process comparison with Traditional Manufacturing(7-8).

**Unit 5 Total Productive Maintenance andReplacement:[06]**

Introduction, Definition, Six big losses, Stages of maintenance(1), Pillars stages of TPM Development(2), Overall Equipment Effectiveness (OEE) (3) Computation Replacement - need, Replacement of items whose maintenance cost increases with time(4) (with and without considering time value of money), Replacement of items that failsuddenly (5-6)

**Unit 6 Production Economics [06]**

Demand and supply, Demand curve and supply curve(1), Equilibrium of supply and demand(2), Elasticity of demand Production function, Factors of production, Isoquants(3), Review - Time value of money, Cash flows(4), Evaluation criteria for capital projects(5) (investment) Payback period, IRR andBCR(6)

## Term Work:

1. Presentation on Case study on "Interdepartmental relationship in a businessorganization"
2. Presentation on Case study on "Design for Manufacturing andAssembly".
3. Assignment on DemandForecasting.
4. Problems on Job sequencing- Single Machine Scheduling, Priority Sequence and Johnson'sAlgorithm.
5. Presentation on Case study on "Implementation of JIT in a small/ mediumcompany".
6. Problems on Estimate OEE and ReplacementAnalysis.
7. Exercises on Analyzing tools in Projectpreparation.
8. Presentation on World Class Manufacturing Practices like Toyoto Mfg. system,etc.

**Text Books:**


1. "Industrial Engineering and Production Management", MartandTelsang, S Chand and Company New Delhi,(2009).
2. "Productions and Operations Management", KanishkaBedi, Oxford Higher Education., 3rd Edition.
3. "Production and Operation Management", Tripathi, ScitechPublications.
4. "Production and Operation Management", S. N. Chary, Tata McgGraw Hill, 5thEdition.
5.


## Reference Books:


1. "Production and Operations Management", Buffa. Elwood modern Wiley India,8thEdition.
2. "Operation Management, Process and Value Chain", Krajewski and Ritzman, Malhotra PearsonEducation.
3. "Production and Operations Management", Ashwathappa, Bhat , HimalayaPublishing
4. "Techniques of Value Analysis and Engineering", MilesLawrence.
5. "Operation Management Theory and Practice", Mahadevan B PearsonEducation,(2007)
6. "Operations Management" Kaither and Frazer, CengagePublication
7. "Production and Operation Management", Everett E. Adam and Ebert, PHI Publication, ISBN no. 9788120308381.

**Final Year B. Tech (Production Engineering) –Semester VII**
**PROCESS ENGINEERING**

**Course Code: PCC-PE404**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5 Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25 Marks |
| | External Oral Exam: 25 Marks |

**Course Objectives:** A Student should be -

1) Able to describe role of process engineer and an ability to prepare process documents
2) Able to analyze given production drawing & required machiningaccuracy
3) Able to findtechnical feasibility of a product by selecting proper manufacturing process
4) Able to select manufacturing equipment& tooling for required component
5) Able to design process plan for job and mass production
6) Student should able to estimate the manufacturing time for various processes

**Course Outcomes:** A Student should have-

1) Ability to prepare process documents
2) Ability to analyze the production drawings.
3) Ability to select proper manufacturing process
4) Ability to select correct manufacturing equipment
5) Ability to design process plan for given component
6) Ability to estimate the manufacturing time

**Unit-1**

**Introduction**: Process planning function and activities-drawing interpretation, material evaluation and process selection, selection of machines and tooling, setting process parameters, work-holding devices, selecting quality assurance methods, costing and documentation, Inputs and outputs for process planning, Position of product and process engineering department in the organization, functions of product and process engineers. **(7)**

**Unit-2**

**2.1 Part Print Interpretation**: Indentifying Originating process, major and minor operations, identifying useful supplementary information, material specification,heat and surface treatments, interchangeability and standardization, screw thread forms, tool references, dimensional and geometrical tolerances, surface finish,

identifying critical processing factors

**2.2 Study of Machining Accuracies**: Factors affecting accuracies, work piece control theories, product tolerances, process tolerances, tolerance stack -types and effects. **(6)**

**Unit-3**

**3.1 Technical Feasibility Study**: Raw material, basic originating process, accuracy level, processes required, machine tools and accessories required manufacturing feasibility study with illustrations

**3.2 Selection of Process**: General guidelines for and factors in process selection, process selection method, process and operation sequencing – guidelines; Combining and eliminating operations, economic aspects of processing (A case should be discussed), Introduction to computer aidedprocess planning-Generative and Retrieval type. **(7)**

**Unit-4**

**4.1 Selection of Equipment**: Various sources of information, technical, economical and managerial considerations, selection criteria for GPMs, SPMs and CNCs for processing in job, batch and mass mode.

**4.2 Selection of Tooling**: Technical specifications of standard cutting tools and gaugesrequired for various machining operations, selection criteria for cutting tools and gauges,study of special tools, gauges and work holding devices, selection of machining parameters. **(5)**

**Unit-5**

**Process Sheet Designfor job, batch and mass production**

Study of the parts to be processed, Logical design of a process plan, stock preparations, blank selection with material estimates, Selection of datum features, identification of machining surfaces, incorporation of dimensions including tolerance analysis, selection of machining methods with time estimates and time standard for each operation, Process Picture(Setting drawing) sheet including process symbols, processing dimensions. Process sheet design for complete manufacturing part **(8)**

**Unit-6**

**Time Estimation**: Calculation of standard time and production rates for various operations by consideration of various allowances. (Numerical exercises expected) Tacttime concept. **(4)**

## Term Work:

1) Part print interpretation of one industrial component drawing
2) Study of formats of Process sheets, Process pictures and PPAP documents.
3) Process design of one component (made from casting, forging, bar stock, etc.) onconventional and CNC machine tools for batch production
4) Process design of one component for mass production using SPMs considering combination of operations for achieving targeted cycle time on each SPM.
5) Time estimation for processing a component on conventional and CNC machine toolsfor batch production (one exercise each)
6) Industrial visit to study process designing and its report. During process design, use of cutting tool manufacturers catalogues is essential.

**Note for paper setters:**

**The pattern of question paper shall be as given bellow:**

Q.1 Process Planning using conventional machines-small batch quantity (25 Marks-Compulsory)

Q.2 Process Planning for large batch quantity CNC Lathe or Machining Centre (VMC/HMC) (15 Marks) Compulsory question.

Q4. Numerical exercise on time estimation of one operation setup (10 Marks) Compulsory question.

Q.5 Theoretical / Descriptive questions based on Syllabus with internal options (20 Marks)

## Text Books:


1) Process Engineering for Manufacturing – Eary& Johnson (Prentice Hall)
2) A Text Book of Production Engg, –P.C. Sharma, (Millennium Edition, 2000) S. Chand & Co.


## Reference Books:


1) Process Planning: The Design/Manufacturing Interface, –PetertScallan, (2003), (Buttreworth Heinmann, Elsevier) ISBN: 0-7506-51-29-6
2) Principles of Machine Tools- Sen, Bhattacharya
3) Automation, Production Systems, and C.I.M. – Groover, M.P. 3/e, (PHI)
4) Workshop Technology Vol. III – Chapman (ELBS)
5) Manufacturing Technology: Principles for Optimisation – Daniel
6) Mechanical Estimating and Costing – TTTI Chennai (TMH)
7) Standard manuals of ISO, QS, TS etc.
8) Manufacturers' catalogues for cutting tools and inspection equipments
9) Product Design-Kevin Otto and Kristin Wood (Pearson)
10) All About Machine Tools-Heinrich Gerling (New Age International)
11) Westerman Tables (Metals) (New Age International)
12) Production Drawing- Narayana K.L., Kannaiah P., Venkata Reddy K., New age International Publishers

**Final Year B. Tech (Production Engineering) –Semester VII**

# ELECTIVE – I: 1. AUTOMOBILE ENGINEERING

**Course Code: PCE-PE405**

**TeachingScheme:**
Lectures: 3 Hrs. / Week TheoryPaper(2.5 Hrs)
Practical: 2Hrs./Week/Batch
Credits: 4

**Examination Scheme:**
ESE: 70 Marks
CIE: 30Marks
Term Work: 25Marks
External Oral Exam: 25 Marks

**Pre-requisites:** Knowledge of Statistics and management is required**.**

**Course Objectives:** A Student should be -
To study the fundamentals, types, construction and working principles of automobiles and its parts & systems

**Course Outcomes:** A Student should have-The knowledge of the fundamentals, types, construction and working principles of automobiles and its parts &systems.

**Unit-1:**

**Introduction to Automobiles:**
Classification of Automobiles, Major Components and their functions, Vehicle Specifications, Types of vehicle drive layouts for four wheelers, Drive layouts for two and three wheelers, Types of automobile bodies, Body construction and different materials for modern automobiles, Articulated vehicles, Selection of engines for different automobiles based on different criteria. Fuel cells, Electric vehicles, Hybrid Vehicles, Advantages and Limitations.

**Fuel Supply Systems for SI Engines:** Carburetion, air fuel requirements for SI engines under various operating conditions, essential parts of a modern carburetor, different circuits, carburetors used on automobiles, fuel injection in SI engines.

**Fuel Supply Systems for CI Engines:** Functional requirements of an injection system, typical arrangement of solid injection system, individual pump and; nozzle system, unit injectors, distributor system, fuel injectors, types of nozzles.

**Ignition Systems:** Battery ignition system, magneto ignition system, electronic ignition systems, waste spark ignition system. Different starting systems usedinautomobiles. **(10)**

**Unit-2:**

**Study of Clutches and Gear Boxes:**

**a) Clutches:** Types of clutches, single plate, multiplate, centrifugal clutches, clutch operating systems, wet clutches, fluid coupling, and clutchplatematerials. **(3)**

**b) Gear Boxes:** Functions of gear box, various resistances to motion, rolling, air and gradient resistance, total resistance and tractive effort, variation of tractive effort with speed, power required for acceleration and gradiability, selection of gear ratio, sliding mesh, constant mesh and epicyclic gear boxes, synchromesh devices, automatic gear boxes, torque converters, overdrive, propeller shaft**.(5)**

**Unit-3**

**Control Systems of Automobiles:**

**a) SteeringSystem:**

Functions of steering system, Steering system layout, Types of automotive steering mechanisms, Types of steering gear boxes, Steering geometry-Camber, Caster, King pin inclination, included angle, Toe-in and Toe-out, Wheel alignment, Slip angle, Condition of under steer & over steer, Types and working of powersteering. **(5)**

**b) BrakingSystem:**

Requirements and functions of automotive braking system, Types of braking mechanisms Internal expanding brakes, Disc brakes, Hydraulic& Air brake systems, Servo and power brakes, Anti lock and antiskid braking, Calculation of braking force required, stopping distance and dynamic weight transfer (Numerical) **(5)**

**Unit- 4**

**Study of Suspension Systems:**

Objects of suspension, principles of suspension design, spring and unspring mass, types of springs, variable rate springs, torsion bars, rubber springs, shock absorbers, independent suspension, air suspension, interconnected suspension, hydro pneumatic suspension, self leveling suspension.**(3)**

**Unit- 5**

**Electrical and Electronics Systems of Automobiles:**

Automotive batteries, lighting system. Starting system, Charging system, Voltage and current regulator, Electric horns and types, Dash board gauges, Wiper & side indicator Circuits, Engine electronic control modules, Microprocessors, Sensors, Safety devices, Recent developments in automobile electronics systems. **(4)**

**Unit-6**

**Automobile Maintenance:** Preventive maintenance, troubleshooting and diagnosis for the systems that constituteanautomobile. **(2)**

## Term Work:

Minimum eight experiments from Group A and all experiments from Group B shall be performed

**Group A:**

1. Study and demonstration of four wheeler chassis layout. Two-wheel & four-wheel drivelayouts.
2. Study and Demonstration of working of single plate automobileclutch.
3. Study and demonstration of synchromeshgearbox.
4. Study and demonstration of final drive anddifferential.
5. Study and demonstration of working Hydraulic brakingsystem.
6. Study and demonstration of front wheel steering geometry and steeringmechanism.
7. Study and demonstration of suspension system of afour-wheeler.
8. Study and demonstration of electrical charging system ofautomobiles.
9. Study and demonstration of electrical starting system ofautomobiles.
10. Study and demonstration of electric horn, fuel gauge and wiper circuit ofautomobiles

**Group B:**

1. Experiment on wheel balancing & front wheelalignment.
2. Visit to servicing station for study of vehicle maintenance, repairs andreport.

**Reference Books:**


1) W. H. Crouse, "Automotive mechanics", Tata McGraw Hill Publishing Company Ltd, New Delhi, Ninth Edition, Delhi, 1993.,ISBN0070634351
2) Kirpal Singh, "Automobile Engineering",Vol. II,Standard Publishres Distributors,(2009), ,ISBN8180141241
3) Narang G. B. S., "Automobile Engineering", S. Chand and Company Ltd, Fifth Edition, Delhi, 1995. Motor Vehicle: Newton &Steeds
4) Newton, Steeds and Garrett. "Motor Vehicle", The English Language Book Society, Ninth Edition, 1972.
5) Heitner Joseph, "Automotive Mechanics" CBS Publishers and Distribution, Second Edition, Delhi, 1987.
6) Automobile Mechanics: N. K.Giri
7) Automobile Engineering; R. K. Rajput
8) Automobile Engineering:K.K.Ramalingam
9) Automobile Electrical Equipment; P. L.Kohali
10) P. L. Ballaney, "Internal Combustion Engines", Khanna Publishers, Third Edition, New Delhi, 1991.
11) P. W. Gill, J. H. Smith, et.al, "Fundamental of I.C. Engines", Oxford and IBH Publishing Co. Pvt. Ltd., (2007) ,ISBN8120417100
12) Arkhangelsky V. et.al., "Motor Vehicle Engines", MIR Publishers,Mascow1976.

**Final Year B. Tech (Production Engineering) –Semester VII**

## ELECTIVE – I: 2. ENERGY ENGINEERING

**Course Code: PCE-PE405**

| **TeachingScheme:** | **ExaminationScheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5 Hrs): | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |
| External Oral Exam: 25 Marks | |

**Course Objective:**

To understand the fundamentals of energy engineering and its applications.

**Course Outcome:**

The students shall demonstrate the knowledge of the fundamentals of energy engineering and its applications.

**Unit-**

**1.Introduction:**

Fossil fuel based systems, Impact of fossil fuel based systems, World scenario of Energy Resources, Indian Scenario of Energy Resources now and Renewable energy – sources and features, Distributed and dispersedenergysystem. **(3)**

**Unit-2**.

**A) Solar ThermalSystem:**

Solar potential, Solar radiation spectrum, Solar radiation geometry, Solar radiation data, Radiation measurement, Technologies of thermal energy collection, Applications of Solar Energy, Photovoltaic cell concepts, Operating Principle, Photo-cell materials, Cell modulearray,Applications. **(5)**

**B) Fuel Cells:**

Introduction, Principle and operation of fuel cells, classification and types of fuel.Fuel for fuel cells, performance characteristics of fuel cells, application offuelcells. **(4)**

**C) WindEnergy:**

Wind parameters and wind data, Power from wind, Site selection, Construction and working of typical wind mill, characteristics of wind generators, Design considerations for wind mills, Operation

and maintenance of wind mills, present status. Introduction to Ocean energy, Tidal energy, Geothermal Energy,HybridSystems. **(5)**

**D) Biomass:**

Introduction, Anaerobic digester, Biomass gasification, Pyrolysis, various applications of Biomass energy, Bio-fuel – Relevance, types,andapplications. **(3)**

**Unit-3**

**Energy Auditing**

Need for energy audit, Types of energy audits, components of energy audit, energy audit methodology, analysis and recommendations of energy audit—examples of different applications, introduction to energyauditsoftware. **(7)**

**Unit-4**

**Energy Economics**

Determination of cost of steam, natural gas, compressed air and electricity. Financial analysis techniques - simple payback, Time value of money, Net present value (NPV),Return on investment (ROI),Internal rate of return (IRR), Risk andsensitivityanalysis. **(6)**

**Unit-5**

**Electrical Energy Management**

Electricity billing, Power factor improvement, and its benefit, Electricity act 2003, Lamp types and their features, recommended illumination levels, lighting systemenergyefficiency. **(3)**

**Unit-6**

**A) Cogeneration and Waste heat recovery**

Cogeneration— Need, applications, advantages, classification, Commercial WHR devices, saving potential. **(2)**

**B) CDM projects and carbon creditcalculations**

Introduction to CDM projects, carbon credits and its calculation, carbonfootprint. **(2)**

## Term Work:

The term shall consist of performing any Six of the following experiments.

1) Demonstration and measurement of Solarradiation.
2) Test and Trial on Solar flat platecollector.
3) Performance evaluation of PVcell.
4) Energy Audit – Case Study of anorganization.
5) Visit to Wind Powerplant.
6) Study and demonstration of fuel cell,application.
7) Visit to Biodieselplant.

**Reference Books:**


1) Solar Energy by Dr. S.P. Sukhatme Tata McGrawHill.
2) Non-Conventional Energy Sources by G.D. Rai.-KhannaPublishers.
3) Energy Technology by S. Rao, Dr. B.B. ParulekarKhannaPublishers.
4) Energy Engineering by R.S. Kulkarni& Dr. S.V.Karmare.
5) Non Conventional Energy Sources by Dr. L.Umanand.
6) Introduction to Non-Conventional Energy Resources by Raja, SciTechPublications

**Final Year B. Tech (Production Engineering) –Semester VII**

## ELECTIVE – I: 3. COMPOSITE MATERIALS AND TECHNOLOGY

**Course Code: PCE-PE405**

**TeachingScheme:**
Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs):
Practical: 2Hrs./Week/Batch
Credits:4

External Oral Exam: 25 Marks

**Examination Scheme:**

ESE: 70 Marks
CIE: 30Marks
Term Work: 25Marks

**Course Objectives:**

1) To introduce students the field of Composite Materials used in various engineeringapplications
2) To understand use and Fabrication of polymer matrix and Ceramic matrixcomposites
3) To study various StructuralComposites
4) To study various Composite materials for optical and magneticapplications.

**Course Outcomes:**

1) Students will able to introduce the field of Composite Materials used in variousengineering applications
2) Students will able to understand use and Fabrication of polymer matrix and Ceramic matrix composites
3) Students will able to study various StructuralComposites
4) Students will able to study various Composite materials for optical and magneticapplications.

**Unit -1**

Composite materials in engineering, reinforcing materials: fibers, whiskers and particles. Fiber materials for composites, Fibers of glass, boron, carbon, organic, ceramic and metallic fibers, Matrixmaterials,Interfacesbetweenmatrixandfibersandotherdispersedphases.**(6)**

**Unit -2**

Polymer matrix composites, Characteristics and applications, Fabrication of polymer matrix composites, Metal matrix composites (MMC), Fabrication of MMCs by liquid state, solid state

methods, powder metallurgy route and in site fabrication methods, Discontinuous reinforcement of MMCs, Ceramic matrix composites, Fabrication methodsandapplications. **(6)**

**Unit -3**

Mechanical properties in composites, large particle composites and the rule of mixtures for elastic constants, Mechanical properties of fiber reinforced composites, Effect of fiber length, Critical fiber length, Strength of continuous and aligned fiber composites, Discontinuous and aligned fiber composites, Toughening Mechanism, Impact Resistance, Fatigue and Environmental Effects.**(6)**

**Unit -4**

Structural Composites: Cement matrix composites, Steel Reinforced Concrete, Pre- stressed concrete, Thermal Control, Vibration reduction. Polymer matrix composites-vibrationdamping.**(6)**

**Unit -5**

Composite materials for Electrical, Electromagnetic and Dielectric applications, Microelectronics and Resistance heating, Electrical insulation, capacitors, piezoelectric, ferroelectric functions, electromagnetic windows, solid electrolytes,microwaveswitching. **(6)**

**Unit -6**

Composite materials for optical and magnetic applications, optical waveguide, optical filters and lasers, multilayer formagneticapplications. (6)

## Term Work:

The term work shall consist of the following.

1) Assignment on study and application of engineeringcomposites.
2) Assignment on study of Metal matrixcomposites.
3) Assignment on study of Mechanical properties of fiber reinforcedcomposites.
4) Assignment on study of Structural Compositematerials.
5) Assignment on study of Composite materials for Electrical, Electromagnetic and Dielectric applications.
6) Assignment on study of Composite materials for optical and magneticapplications.

## Text Books:

1) Principles of Materials Science and Engineering, William F. Smith, Third

Edition, 2002,McGraw-Hill

**Final Year B. Tech (Production Engineering) –Semester VII**

## ELECTIVE – I: 4. EXPERIMENTAL STRESS ANALYSIS

**Course Code: PCE-PE405**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |
| External Oral Exam: 25 Marks | |

**Course Objective:**

To familiarize the students with state of the art experimental techniques namely strain gauges, photo elasticity, interferometry, coating techniques, Moire fringes and holography employed in stress analysis.

**Course Outcome:**

The students shall demonstrate the knowledge of the state of the art experimental techniques namely strain gauges, photo elasticity, interferometry, coating techniques, Moire fringes and holography employed in stressanalysis.

**Unit-1**

**Introductory Principles**

Basic concepts of experimental stress analysis (ESA), advantages, necessity of various ESA methods, methodology of problem solvingbyESA. **(4)**

**Unit-2**

**Strain Measurement Techniques**

Introduction to strain measurement, Review of stress, strain and Hooke's law, Definition of stress and strain tensors, Strain gauges, Properties of strain gauge systems, Types of strain gauges, Mechanical and Optical strain gauges, Electrical strain gauges, LVDT, resistance strain gauges, Gauge factor, Materials for adhesion base etc, Recording instruments, static anddynamicrecording. **(8)**

**Strain AnalysisMethods**

Three element rectangular strain rosette, correction, stress gauges, over-deterministic methods for strain analysis, residual stress determination, Applications of strain gauges for measurement of load, temperature, pressure, vibration, stressandstrain. **(4)**

**Unit-3**

**Optical methods of Stress Analysis**

Basics of optics, Optical instrumentation, Moire fringe technique – theory and experimental procedures, Fractional fringe measurement, Tardy's method, BabinetSoleilmethod. **(5)**

**Unit-4**

**Theory of Photo elasticity – Two dimensional photo elasticity**

Introduction, Temporary double refraction, Polariscope – Plane and Circular, Stress optic law, Different arrangements, photo elastic photography, properties of photo elastic materials, Selection, casting methods, calibration. Analysis techniques – determination of direction of principal stresses at a given point, determination of exact fringe order N and the principal stress separation methods, Method based on Hooke's law, Electrical analogy method, Shear difference method, Model to prototype scaling. **(8)**

**Unit-5**

**Three dimensional photo elasticity**

Stress freezing method, General slice, Effective stresses, stress separation, Shear difference method, Secondary principal stresses, Scattered lightphotoelasticity **(5)**

**Unit-6**

**Coating Methods**

Birefringent coating techniques, Stress-optic and strain-optic relation, Sensitivity and coating materials, Fringe order determination, Brittle coating technique,Moiretechnique. **(4)Holog**

**raphy**

Introduction, Plane and spherical waves, coherence, holographic set-up, Interferometry – Displacement measurement,Isopachics. **(2)**

## Term Work:

Minimum six assignments based on the above topics including two exercises involving analysis.

**Text Books:**


1) Dally and Riley, "**Experimental Stress Analysis**", McGraw Hill Book Company,1991.
2) L. S. Srinath, "**Experimental Stress Analysis**", Tata McGraw Hill Book Company, New Delhi,1984.
3) Sadhu Singh, "**Experimental Stress Analysis"**, Khanna Publishers, New Delhi,1996.


**Reference Books:**


1) Holman, "**Experimental Methods for Engineers**", 7th Edition, Tata McGraw Hill Book Companies, Inc, New York, 2007
2) R.S Sirohi, H.C. Radhakrishna, " **Mechanical Measurements**", New Age International Pvt. Ltd, New Delhi,2004.
3) Perry and Lissner, "Strain Gauge Primer", McGraw Hill, 1962.
4) Doeblin E. A., "Measurement Systems Application and Design", McGraw Hill, New York,1989 M.M. Frocht, "PhotoelasticityVol I and Vol II" John Wiley and Sons,1969.
5) CompositeMaterials:EngineeringandScience,MatthewsF.L., andRawlingsR.D.,1999, WoodheadPublishingLimited,CambridgeEngland.
6) Composite Materials-Functional Materials for Modern Technology, DDL Chung, Springer-Verlag PublicationsLondon.
7) The nature and Properties of Engg. Materials, Jastrzebaski, John Wiley & Sons, New York.
8) Composite Materials Handbook, Mel M. Schwartz (R), 2nd Edition, 1992, McGraw-Hill, NewYork.
9) Fundamentals of Fiber Reinforced Composite Materials, A. R. Bunsell, J. Renard , 2005, IOP PublishingLtd, Composite Materials Science and Engg., Chawla K.K., second edition 1998 springer verlag.,

**Final Year B. Tech (Production Engineering) –Semester VII**

## ELECTIVE – I: 5. SAFETY ENGINEERING

**Course Code: PCE-PE405**

**TeachingScheme:**
Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs)
Practical: 2Hrs./Week/Batch
Credits: 4

**Examination Scheme:**

ESE: 70 Marks
CIE: 30Marks
Term Work: 25Marks
External Oral Exam: 25 Marks

**Course Objectives:**

To understand the fundamental concepts of safety engineering and learn the techniques for identification and control of industrial hazards

**Course Outcome:**

The student shall demonstrate the knowledge of fundamental concepts of safety engineering and the techniques for identification and control of industrial hazards

**Unit-1**

Industrial safety, Hazard identification and risk assessment, Preliminary hazard analysis (PHA), Failure mode effect analysis (FMEA), Job Safety Analysis, Accident causation, Accident investigation, Root causeanalysis **(6)**

**Unit-2**

Safe design of plant layout and facilities, Emergency response preparedness, Designing safety features in machine and equipment, Poka-yoke for safe design and operation, Machine and equipment guarding, Personalprotectiveequipment **(6)**

**Unit-3**

Foundry processes: Effects of heat, dust, and noise on worker fatigue and productivity, Working in hot environment, Hazards and safety precautions in melting, moulding, core making, fettling, and foundry materialhandling **(6)**

**Unit-4**

Metalworking processes: Hazards in hot forging and rolling operations, Safety in handling, storage and changeover of dies and rolls, Safe use of power presses, Safety precautions in shearing bending, rolling, drawing and othermetalworkingprocesses **(6)**

**Unit-5**

Machining processes: Designing safety features in machine tools, Common hazards in machining processes and their control. Safety in design and operations of material handling equipment.Industrial robots and robot system safety, Work envelope of robots, Sources of hazards in robot operations, Safeguardingpersonnel. **(6)**

**Unit-6**

Safety in maintenance operations, Work Permit Systems, Work in confined spaces, working at height, Fabrication processes: Hazards in welding operations andtheir control. (6)

## Term Work:

Any six of the following assignments, with an emphasis on obtaining and using field data.

1) Preliminary hazard analysis of aworkplace
2) Failure mode effect analysis of a workplace and calculation of risk prioritynumber
3) Improving design of a machine/ equipment using poka-yokeprinciples
4) Visit to a foundry and identification and classification ofhazards
5) Visit to a forging/ rolling industry and identification and classification ofhazards
6) Study of safety features of a roboticsystem
7) Study of safety features of material handlingsystems

**Reference Books:**


1) Industrial Accident Prevention, H W Heinrich, McGraw Hill,1980
2) Occupational Safety Management and Engineering, W Hammer and D Price, Prentice Hall,2000
3) Occupational Safety and Health: For Technologists, Engineers, and Managers. D Goetsch, Prentice Hall, 1999
4) Probabilistic Risk Assessment and Management for Engineers and Scientists, H Kumamoto and E Henley, IEEE Press,1996

**Final Year B. Tech (Production Engineering) –Semester VII**

# ELECTIVE – I: 6. RAPID PROTOTYPING

**Course Code: PCE-PE405**

**TeachingScheme:**
Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs)
Practical: 2Hrs./Week/Batch
Credits: 4

**Examination Scheme:**

ESE: 70 Marks
CIE: 30Marks
Term Work: 25Marks
External Oral Exam: 25 Marks

**Course Objective:**

To study the concepts and applications of rapid prototyping and rapid manufacturing

**Corse Outcome:**

The students shall have the knowledge of concepts and applications of rapid prototyping and rapid manufacturing.

**Unit-1**

**Introduction to Rapid Prototyping:**

Definition of rapid manufacturing (RM), rapid prototyping (RP) and rapid manufacturing, areas of application. Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification, RP Processes: Process overviews, STL file Generation, File Verification &Repair, Build File Creation, Part Construction, Part Cleaning and finishing, Process Strength&limitations. **(6)**

**Unit- 2**

**Design Potential of Rapid Prototyping**:

Conventional design for manufacturing and assembly (DFM, DFMA), impact of RM on DFA and DFMA, Geometrical freedom, design complexity/ optimization, parts consolidation, body fitting customization and multiple assemblies manufactured as one, Customer input and customization, CAD environmentfor RM. **(6)**

**Unit- 3**

**Rapid Prototyping Processes-I:**

a. Stereo lithography **(SLA):** Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages andDisadvantages.

b. Laminated Object Manufacturing **(LOM):** Models and specifications, Process, working principle, Applications, Advantages andDisadvantages.

**c.** Fused Deposition Modeling **(FDM)**: Models and specifications, Process, working principle, Applications, AdvantagesandDisadvantages. **(6)**

**Unit- 4**

**Rapid Prototyping Processes-II:**

a. Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Casestudies.

b. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages andDisadvantages.

**c.** Laser powder forming: Models and specifications, Process, working principle, Applications, AdvantagesandDisadvantages. **(6)**

**Unit- 5**

**Materials in RM**:

Issues, viscous flow, photo-polymerization, sintering, infiltration, mechanical properties, Materials for RM processes, Prototype properties: Material properties, color, dimensional accuracy, stability, surface finish, machinability, Functionally graded materials (FGM composites), processing technologies for FGMs,thermalandmechanicalpropertiesofFGM,Depositionsystemsandapplications.

**(6)**

**Unit-6**

**Applications ofRP:**

Form and fit checking, Ergonomic Studies, Functional testing, Automotive applications- Parts ofracing cars, Applications in Aerospace industry, Construction industry, Applications in Medical field , Rapid Tooling: Mold making, Rapid tooling for die, permanent mold casting, Rapid manufacturing of sheet metal forming tools, casting pattern plates by rapid tooling, RP for series production investment casting.**(6)**

## Term Work:

1) Three Assignments on 3D modeling & STL File generation of industrialcomponents.
2) Assignment on introduction to Rapid manufacturing
3) Study of RP Processes along with working principles, set up, applications, advantages and limitations
4) Assignment on applications of rapid prototyping in various fields like automotive, aerospace, medical, constructionetc.
5) Assignment on rapid tooling along with working principles, setup, applications, advantages and limitations

**Reference Books:**


1) Rapid Manufacturing: An Industrial Revolution for the Digital Age – EditorsN.Hopkinson, R.J.M. Hague and P.M. Dickens, (2006) John Wiley & Sons, Ltd., ISBN-10 0-470-01613-2
2) T. A. Grimm & Associates, Users Guide to Rapid Prototyping, Society of Manufacturing Engineers ( SME ) ISBN0872636976

**Final Year B. Tech (Production Engineering) –Semester VII**

## ELECTIVE – I: 7. RELIABILITY ENGINEERING

**Course Code: PCE-PE405**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |
| | External Oral Exam: 25 Marks |

**Course Objective:**

To understand fundamental concepts of reliability and learn the models for component and system reliability.

**Course Outcome:**

The students shall have the knowledge of fundamental concepts of reliability and the models for component and system reliability.

**Unit-1**

Introduction to reliability, Definitions, Reliability in product life-cycle, Quality, Failures, Failure data, Failure models, Causes of failures, Maintainability and availability, System effectiveness, Redundancy techniques **(4)**

**Unit-2**

Probability, Axiomatic probability, Statistical probability, Rules of probability, Random variables, Discrete distributions: Binomial and Poisson distribution, Continuous distributions: Uniform, Exponential, Weibull, Normal, Rayleigh,Gammadistribution **(6)**

**Unit-3**

Component reliability, Mean time to failure (MTTF), Time-dependent hazard models: Field-data, Constant hazard, Linear hazard, Nonlinear hazard, Gamma model, Stress-dependent hazard models, Markovmodel **(8)**

**Unit-4**

System reliability, Components in series, Components in parallel, k-out-of-m systems, Mixed-mode failures, Fault-tree technique, Failure mode effect analysis (FMEA), Risk priority number (RPN)

**(8)**

**Unit-5**

Maintainability function, Mean time to repair (MTTR), Availability function, Preventive maintenance, Redundancy techniques, Unit redundancy, Component redundancy, Weakest-link technique, Mixed redundancy,Standbyredundancy **(6)**

**Unit-6**

Economics of reliability, Manufacturer's cost, Customer's cost, Reliability achievement cost, Reliability utility cost, Depreciation cost, Availability cost forparallelsystems **(4)**

## Term work:

Any six of the following assignments, with an emphasis on obtaining and using field data.

1) Plotting bath-tub curve using failure data of amachine/equipment/system
2) Estimation of parameters of statistical distribution from failure data of amachine
3) Calculation of hazard rate of a system using appropriate hazardmodel
4) Estimation of failure rate and system reliability using fault-treediagram
5) Comparison of system reliability applying different redundancytechniques
6) Estimation of MTTF, MTTR, and availability of a machine from failuredata
7) Failure mode effect analysis for an equipment/system and estimation of risk prioritynumber

**Text Books:**


1) Reliability Engineering and Life Testing, V N A Naikan, Prentice Hall,2008
2) Reliability Engineering, E Balagurusamy, Tata McGraw Hill,2008


**Reference Books:**


1) Principles of Reliability Engineering, K B Misra, Reliability Engineering Centre, IIT Kharagpur, 2004.
2) Maintenance Engineering and Management, S K Srivastava, S Chand,2008Terotechnology: Reliability Engineering and Maintenance Management, B Bhadury and S K Basu, Asian Books, 2003.

3) Frank W. Liou, Rapid Prototyping & engineering applications, CRC Press, ISBN 978-0-8493-3409-2
4) Rapid Prototyping theory & practice, Manufacturing System Engineering Series, Ali K. Kamarani, SpringerVerlag
5) Rapid Prototyping- case book, J. A. McDonalds, C. J. Ryall, WileyEastern
6) Rapid & Virtual Prototyping & applications, C. E. Bocking, AEW Rennie, WileyEastern
7) Carmen Gabriela BĂCILĂ, Zoltan-Gabor BAKI-HARI , " The Main Applications of Rapid Tooling," RECENT, Vol. 8, nr. 3a(21a), November,2007
8) ANNALS of the ORADEA UNIVERSITY. Fascicle of Management and Technological Engineering, Volume VI (XVI),2007
9) John F. Wallace, David Schwam," Rapid manufacturing of sheet metal formingtools," Case Western ReserveUniversity
10) A. Pereira, J.A. Pérez, J.L. Diéguez, G. Peláez and J.E. Ares, "Design and manufactureof casting pattern plates", by rapid tooling, Archives of Materials Science, Vol. 29, No. 1-2, 200863
11) Using RP for Series Production Investment Castings, Tom Mueller, ExpressPattern

**Final YearB. Tech. (Production Engineering) Part-I, Semester VII**

**INDUSTRIALTRAINING**

**Course Code: SI-PE406**

**Teaching Scheme:**
Not Applicable.
Credits: 1

**Examination Scheme:**
Term work: 25Marks

**Course Objective:**

To expose the students to industrial work systems and working environment.

**Course Outcome:**

The students shall have the knowledge of industrial work systems and working environment.

## Term Work:

Every student shall prepare a report of the industrial training and the case studies carried out during at least a 15 days vocational in-plant training in a prescribed format under the guidance of the Project Guide, before end of Part I, semester VII. The report shall be comprehensive and presented in duplicate, typed on standard A4 size sheet and bound. This will form the term work.

## The Training Contents:

The student shall undergo training program prepared by the industry in following manufacturing and functional area.

1) Plant Engineering: Plant Layout, Plant Maintenance, Housekeeping, Material Handling &safety.
2) Production Planning and Control, QualityAssurance.
3) Material Management: Inventory Control, Vendor Development, Vendor Rating,RawMaterial and Finished Goodsstores.
4) Manufacturing Processes: Machines & Equipments, Its working, Machine / ProcessDiagnosis.
5) Industrial Engineering: Method Study, Work Measurement, Ergonomics andProductivityImprovement Technique.
6) Costing and CostControl.
7) Management Information System (M.I.S.). /Enterprise Resource Planning (ERP)System.
8) Incentive Schemes, Labor Laws. FactoryActs.
9) Quality Assurance, QualityImprovement.
10) Improvement in tool layout, tool selection machineselection.
11) Maintenance of machines, housekeeping, safetyprecautions.
12) Computer based information study for stores, purchase wastage of material, Inprocess
13) Material planning and scheduling, assembly of storage of finish productdispatch.

The students shall submit a detailed report on his/her in-plant training including case studies.

**Notes: The Reports of students undergoing training in the same organization must include different case studies.** The project guide shall assess the term work.

## PROJECT WORK- Phase-I

## Course Code: PW-PE407

**Teaching Scheme:**
Practical: 4 Hrs./Week/Batch

**Examination Scheme:**
Term work: 25 Marks
Oral Exam: 50 Marks

Credits: 4

**Course Objective:**
To prepare the students to carry out a comprehensive study of any design or process or phenomenon, to encourage the process of independent creative thinking and working in groups and to expose them to an industrial atmosphere of accountability.

**Course Outcomes:**
The students shall have the ability to carry out a comprehensive study of any design or process or phenomenon as well as independent creative thinking and working in groups with exposure to an industrial atmosphere of accountability.

**Term Work:**
The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The work started in Semester VII will be continued in the Semester VIII and the final submission of the report will be at the end of the Semester VIII.

The project work may consist of-
1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing it.
4. Experimental verification of principles used in applications related to Production or Mechanical Engineering.
5. A combination of the above.

A synopsis of the selected project work (two to three pages typed on A4 size sheets) will be submitted and assessed by the Project Guide and one more faculty member appointed by the Department / concerned responsible official of the sponsoring industry/Co-guide.
The work to be completed in Semester VII shall include-
**a)** Problem Identification
**b)** Methodology / Design Documents
**c)** Activity planning for the time frame and **division of responsibility to each student**. An interim report of the work completed in Semester VII in the form of workbook /project diary and other relevant documents shall be submitted for the term work. The term work shall be assessed by the Guide and one more faculty member appointed by the Head of the Department. The assessment shall be based on a presentation of the work completed and submission of interim report.

**The oral examination shall be based on the work planned and actually completed in Semester-VII.**

**Final Year B. Tech (Production Engineering) –Semester VIII**

# Costing and Cost Control

**Course Code: PCC-PE408**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Pre-requisites:** Knowledge of Process Planning & Time Estimation is required**.**

**Course Objectives:** A Student should be -

1) Able to describe role of cost estimator and an ability to identify elements of manufacturing cost of a industrial products

2) Able to estimate weight of a product and its material cost

3) Able to estimate cost of a different manufacturing processes

4) Able to allocate and apportion overheads in manufacturing

5) Able to choose and demonstrate of cost accounting methods

6) Student should able to select cost control techniques for minimizing manufacturing cost

**Course Outcomes:** A Student should have-

1) Ability to identify elements of cost.

2) Ability to estimate material cost.

3) Ability to estimate cost of different manufacturing processes

4) Ability to apportion and allocate overheads

5) To select and explain cost accounting methods for problemsolving.

6) To choose cost control method for minimizing cost of a product

**Unit-1 Cost and Cost Estimation[05]**

Concept of cost, cost unit, cost center, classification of cost, elements of cost, Definition of costing, desirable conditions for a costing system. Cost sheet. Cost Estimating: Definition, purpose and functions of estimation, role of estimator, constituents of estimates, estimating procedures.

**Unit-2 Estimation of Weight and Material Cost [08]**

Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost.Purchasing procedure, Inventory Valuation by LIFO, FIFO, Weighted average method.

**Unit 3 Estimation of various processes cost[06]**

Estimation of fabrication, foundry, forging and machining cost. Constitutes, direct cost, indirect cost, Procedure of estimation of cost for each type. Machine hour rate: definition, constituents, direct cost, indirect cost, steps for estimation of machine hour rate for conventional machines, CNC lathe and machining center

**Unit 4 Overheads [06]**

Elements of over-heads, classification, general considerations for collection, analysis of overheads, different methods for allocation, apportionment, absorption of overheads.

**Unit 5 Cost Accounting Methods [05]**

Job costing, Batch costing, Unit costing, Process costing, Contract costing, Activity based costing.

**Unit 6Cost Control[06]**

Budget and budgetary control, standard cost, variance analysis, Cost Reduction Areas: Value analysis and Value engineering, Zero Base Budgeting, Cost Volume profit Analysis, Profit volume ratio.

**Note: Numerical treatment on units1, 2, 3, 4 and 5 is essential**

**Term Work:**Note: Use of computers is essential for at least one exercise.

1. Estimation of weight and material cost for an assembly of three to five components.
2. Valuation of inventory by LIFO, FIFO, Weighted average method
3. Estimation for machine hour rate for representative machines – one conventional machine and one CNC lathe or machining center.
4. Case study on estimation of overheads for a manufacturing unit

5. Study of different methods for allocation, apportionment, absorption of overheads
6. Case study in any one industry using any of the method of costing.
7. Different examples illustrating cost control 8. Case studies of cost reduction. .

**Textbooks:**


1. A Text Book of Estimating and Costing Mechanical – J.S. Charaya& G. S. Narang(SatyaPrakashan)
2. Mechanical Estimating and Costing by B.P.Sinha, (TMH)
3. Estimation and Costing by Banga& Sharma, (Khanna)
4. Mechanical Estimating & Costing by Singla, Aggrawal, (Kaston Publication)
5. A Text-Book Of Mechanical Estimating And Costing by O. P Khanna (DhanpatRai Publications)


**Reference Books**


1. Principles & Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.)
2. Mechanical Costing & Estimation by Sinha, (McGraw Hill Education India Pvt Ltd)
3. Costing Simplified: Wheldom Series – Brown &Owier (ELBS)
4. Cost Accounting: B. Jawaharlal (TMH)
5. Cost Accounting, 13/e - B. K. Bhar, (Academic Publishers, Kolkata)
6. Cost Accounting: by Jain, Narang (Kalyani Publishers)

**Final Year B. Tech (Production Engineering) –Semester VIII**
**INDUSTRIAL ENGINEERING**
**Course Code: PCC-PE409**

**TeachingScheme:**
Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs)
Practical: 2Hrs./Week/Batch
Credits: 4

**Examination Scheme:**
ESE: 70 Marks
CIE: 30Marks
Term Work: 25Marks

Practical Oral Examination: 25 Marks

**Course Objective:**

To acquire interdisciplinary knowledge of method study, work measurement techniques and ergonomics for the overall improvement of productivity and effectiveness.

**Course Outcomes:**

The student shall demonstrate an interdisciplinary knowledge of method study, work measurement techniques and ergonomics for the overall improvement of productivity and effectiveness.

**Unit-1**

**Introduction** to Productivity and Work Study: Definition and scope, Productivity and quality of life, Evolution of work study, contribution of Taylor and Gilbreth, Work study techniques and basic procedure, Human factor in application ofwork-study.

**Method study:**

a) Definition, objectives and basicprocedure.

b) Record,Examine,Develop–Processchartsymbols,Outlineandflowprocesscharts,Flowdiagrams, Critically Examine Techniques

c) Movement of workers and material – string diagram, flow process charts worker Material and equipment type, multiple activity chart – Man – Machine, Machine- Machine chart, Travel charts for workplace

d) Methods and Movements at workplace- Principles of motion economy, Classification of movements, Two handed process chart, SIMO chart, Micro Motion study,Therbligs.

**e)** Evaluate, Define, Install andMaintainmethods **(12)**

**Unit-2**

**Working conditions and Environment:** Occupational hazards, health and safety, housekeeping, lighting, noise and vibrations, climatic conditions, ILOnorms

**Ergonomics:** Human factor engineering, man- machine interaction, **Design of controls, environment factors, Anthropometry,workplacedesign. (5)**

**Unit-3**

**Value Engineering:** Introduction, Concept, Difference between Value Engineering and Value Analysis, Casestudy. **(2)**

**Unit-4**

**Work Measurement:**

Definition, objectives, basic procedure, Techniques of work measurement, Time study – Equipment and forms, selection of a job, steps in time study, breaking the job into elements, timing the elements; Rating in time study – standard rating and standard performance, factors affecting rate of working, standard time determination, use of time standards, allowances.

Work sampling –Need, procedure for work sampling, determining time standard by work sampling.

Predetermined time standards (PTS) – definition, methods time measurement (MTM) standard data from PTS, applications of PTS

MOST (Maynard Operation Sequence Technique) –Introduction,Methodology **(9)**

**Unit-5**

**Location Layout:**

Factors affecting site selection, factors affecting layout design, types of layout, systematic layout planning procedure, travel chart, information gathering, flow analysis and activity analysis relationship diagram, space requirement and availability, designing of layout – use of CAD; Material Handling Systems– Principles, functions and equipments, **selection of MH systems, unit load concept in MH, Economics of materialhandling. (5)**

**Unit-6**

**Job Evaluations and Merit Rating:** Job analysis, Ranking system, Grade description system, Point system, Factor comparison system; Method of merit rating systems,

**Incentives:** Types of Incentives, Relationship of motion and time study withtheincentives. **(5)**

## Term Work:

1. At least one industrial visit to study applications related to the subject and submission of the relevantreport.
2. Method study with present and proposed methods for a manufacturing relatedtask
3. Design and drawing of work place layout in a manufacturing environment considering Ergonomicsfactors
4. Industrial case study on Plant layoutdesign.
5. Time study for a processing operation on a job and calculation of standardtime
6. One experiment on micro motion study with the help of video camera. / Case study on Job & merit rating/ Case study on relationship of motion & time study withincentives.
7. A case study on ValueEngineering.

**Reference Books:**


1. Work Study: - I LO
2. Work Study: - Curie and Faraday(ELBS)
3. Industrial Engineering Handbook, Maynard (McGrawHill)
5. Time and Motion Study Design, Barnes, R.M. (John Wiley)
4. Work Study & Ergonomics, L.C. Jhamb(Everest)
5. Facility Layout and Location – An Analytical Approach, Francis et. al.(PHI)
6. Facilities Planning – 3/e, Tompkins, White, Bozer, Tanchoco (John Wiley &Sons)
7. Job Evaluation -ILO
8. Payment by Results, -ILO
9. Work Study by O.P. Khanna ( DhanapatRaiandSons)

**Final Year B. Tech (Production Engineering) –Semester VIII**

# FINITE ELEMENT ANALYSIS

**Course Code: PCC-PE410**

**TeachingScheme:**
Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs)
Practical: 2Hrs./Week/Batch
Credits: 4

**Examination Scheme:**

ESE: 70 Marks
CIE: 30Marks
Term Work: 25Marks

Practical Oral Examination: 25 Marks

**Pre-requisites:** Knowledge of Engineering Materials, strength of materials and theories of failure, Fundamentals of Programming Language

**Course Objectives:**

1) To understand Finite Element Methods
2) To develop an ability to
3) Analyze 1D, 2D structural analysis problems
4) Analyze thermal analysis problems
5) Use of translators for import export of CAD models.

**Course Outcomes:** Students are able -

1) To calculate deflection, stress and strain in structural analysis
2) To calculate temperature at various nodes
3) To select and use appropriate translator for CAD data

## Unit-1:(8)

**Introduction to Finite Element Method:** Basic Concept, Historical Background, Engineering applications, general Description, comparison with other methods.

**Fundamental of Solid Mechanics:**concepts of Stress Strain Curve, Plane stress and strain, Principal stress and strain, yield criteria- Tresca and Von-Mises.

**Introduction to different approaches used in FEA:** Potential energy Method, Raleigh Ritz method, weighted residual Method.

## Unit-2: (8)

**Finite Element Techniques:** Module boundary value problem, finite element decartelization, element shapes, sizes and node locations, interpolation functions, derivation of element equations, connectivity, boundary conditions, FEM solutions, post processing, Compatibility and completeness requirements,

convergence criteria, higher order and iso-parametric elements, natural coordinates, Lagrange and Hermit Polynomials.

### Unit-3:(8)

**Analysis of 1D element:** Formulation of elemental stiffness matrix and load vector for spring and bar elements, Properties of stiffness matrix, Assembly of global stiffness matrix and load vector, Boundary conditions, elimination method and penalty approach, displacement, Stress and strain calculations in springs and bar elements, Shape functions and its properties.

### Unit-4: (8)

**Analysis of 2D truss element:** Formulation of elemental stiffness matrix and load vector for 2 D element, Calculations of displacement, stress and strain, Analysis of 2D plane element, Calculation of stress, strain.

### Unit-5: (5)

**Applications to Heat Transfer Problems:** Variational approach, Galerikn approach, one dimensional and two dimensional steady state problems for conduction, convection and radiation, transient problems.

### Unit-6: (5)

**Standards for CAD:** Need, Graphics and Computing standards, Data Exchange standards, Communications Standards.

## Term Work:

1. Analysis of spring element using any suitable software
2. Analysis of bar element using any suitable software package
3. Analysis of 2D spar truss any suitable software package
4. Area meshing exercise
5. Study of translators
6. At least two meshing exercises based on free and mapped meshing
7. Mini-project based on CAD and CAE software#.

# Any type of case study using CAD, CAE software can be considered for Mini-project.

External oral should be based on term-work only.

**Textbooks:**

1) Rao, S. S., Finite element method in engineering, 5th Edition, Pergaman Int. Library of Science, 2010.

2) Chandrupatla T. R., Finite Elements in engineering, 2nd Edition, PHI, 2013.

3) Finite Element Methods: Basic Concepts and applications/ Alavala/PHI Publications.

4) Logan, D. L., A first course in the finite element method,6th Edition, Cengage Learning, 2016.

**Reference Books:**

1) Fagan M. J., ―Finite Element Analysis, Theory and Practice, Pearson Education Limited

2) Gokhale N. S., Deshpande S. S., Bedekar S. V. and Thite A. N., ―Practical Finite Element Analysis, Finite to Infinite, Pune

3) Cook R. D., et al. "Concepts and Application of Finite Elements Analysis"- 4 th Edition, Wiley & Sons, 2003.

4) Seshu. P. "Textbook of Finite Element Analysis" Prentice Hall of India, 2003.

5) J.N. Reddy, "Finite Element Method" Tata McGraw Hill, 2003.

**Final Year B. Tech (Production Engineering) –Semester VIII**

**ELECTIVE – II: 1. PRODUCT DESIGN AND DEVELOPMENT**

**Course Code: PCE-PE411**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objectives:**

To understand the basic as well as the advanced knowledge of product design and development process and its application.

**Course Outcomes:**

The students shall demonstrate the knowledge of basic as well as the advanced product design and development process and its application.

**Unit-1**

**Introduction to Product Design & Development:(6)**

Definition Of Product Design, Design By Evolution And Innovation, Factors In Product Design, Morphology Of Product Design (Seven Phases), Standardization, Simplification and Specialization In Product Design, Modern Approaches- Concurrent Design and Quality Function Deployment (QFD), Product Development, Product Development versus Product Design, Types Of Design And Redesign, Modern Product Development Process, Product Development Team And Product Development Planning With Reference To ISO Standard, Difference Between Product Verification And Production Validation, Introduction To Prototyping, RapidPrototypingMethods.

**Unit- 2**

**Product Development - Technical and Business Concerns:(6)**

Technology Forecasting and Technology S-Curve (Technology Stage), Mission Statement and Technical Questioning, Economic Analysis of Product, Customer Needs and Satisfaction, Customer Population and Market Segmentation, Customer Needs-Types and Models, Gathering Customer Needs Information, Analysis *of*GatheredInformation.

**Unit- 3**

**Product Development from Concept to Product Function:(7)**

Generating concepts, information gathering, and brainstorming, morphological analysis, concept selection-design evaluation, estimation *of* technical feasibility, concept selection process, Pugh's concept, selection charts, numerical concept scoring, process of concept embodiment, system modeling, FMEA, functional modeling and decomposition, fast method, subtract and operate procedure, establishing system functionality, augmentationandaggregation.

**Unit-4**

**Product Development in the Context of Reverse Engineering:(7)**

Product Teardown Process, Tear Down Methods - Force Flow Diagrams, Measurement and Experimentation, Applications of Product Teardown, Benchmarking Approach and Detailed Procedure, Tools Used In Benchmarking - Indented Assembly Cost Analysis, Function -Form Diagrams, Trend Analysis, Setting Product Specifications, Introduction to Product Portfolio and Architecture

**Unit-5**

**Design for Manufacture, Assembly and Environment:(7)**

Design guidelines, design for manufacture, design for assembly, design for piece part production, manufacturing cost analysis, need and importance of design fo*r* environment, global, local and regional issues, basic DFE methods-guidelines and applications, life cycle assessment - basic method, weighed sum assessment method, life cycle assessment method, DFX, product testing, product validation, field trials, virtualtrials,iterations.

**Unit-6**

**Introduction to Product Life Cycle and Product Data Management:(7)**

Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components/Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement, Product Data and Product Workflow, The Link Between Product Data and Product Workflow, Different Phases of Product Life Cycle and corresponding technologies. Reliability concepts inproductdevelopment.

## Term Work:

The term work shall consist of total Six assignments based on each of the above mentioned units.

**Text Books & Reference Books:**


1) Kevin Otto and Kristin Wood" Product Design: Techniques in Reverse Engineering and New Product Development," Pearson EducationInc.
2) A.K. Chitale; R.C. Gupta, "Product Design and Manufacturing" Prentice HallIndia

**Final Year B. Tech (Production Engineering) –Semester VIII**

**ELECTIVE – II: 2. ADVANCED MACHINE DESIGN**

**Course Code: PCE-PE411**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objectives:**

1) To understand the fundamentals of elasticity in comparison with the mechanics of deformablebodies.
2) To develop systematic knowledge of basic concepts like stress, strain, equilibrium, compatibility and failuretheories.
3) To relate the stresses and strains in terms of elastic constants and understand the importance of these constants.
4) To become acquainted with the fundamental concepts of stress analysis in two dimensions using stressfunctions.
5) To understand the behavior of prismatic bars subjected totorsion.
6) To understand the concept of strain energy and the relevant energy methods for the solution of engineeringproblems.

**Course Outcomes:**

At the end of this course the students will be able to -

1) Be proficient with the basic concepts of elasticity and understand the limitations of the 'Strength of Materials'.
2) Apply the analytical techniques to :(i) determine internal forces, stresses and strains ( ii) predict failure of simplecomponents.
3) Characterize materials with elastic constitutiverelations.
4) Obtain solutions to simple beam problems (cantilever, simply supported) using stressfunctions.
5) Seek stresses in prismatic bars subjected to torsion (using membrane, soap-filmanalogy).
6) Utilize the energy methods and obtain solutions to elastic bodies subjected to variousloads.

**Unit- 1**

**Analysis of Stress:**

Basic concepts: Body force, Surface Force, Stresses, Components of Stresses, State of stress at a point, Stress components on an arbitrary plane, Principal stresses, Shear stresses, Stress

transformation, Introduction to Mohr's circle, Plane stress, Differential equations of equilibrium, Boundary conditions, Stress invariants, Octahedral stresses, Decomposition of a stateofstress. **(9)**

**Unit- 2**

**Analysis of Strain:**

Deformation, Strain displacement relations, Strain components, State of strain at a point, Dilatation, Compatibility conditions,Planestrain **(5)**

**Unit- 3**

**Stress- Strain relations:**

Generalized Hooke's Law in terms of elastic constants, Relations between elastic constants, Displacement equations of equilibrium, SaintVenant'sprinciple. **(4)**

**Unit- 4**

**Two dimensional problems in Cartesian co-ordinates:**

Airy's stress function, Biharmonic equilibrium equations, Study of simple beam problems: (a) Bending of a cantilever beam with end load, (b) Simply supported beam with uniform load. **(4)**

**Unit- 5**

**Analysis of axi-symmetric problems and Torsion:**

**Axi-symmetric problems:** General equations in polar co-ordinates, Thick-walled cylinder subjected to external and internal pressure

**Torsion:** Torsion of prismatic (circular and elliptical cross-section) bars, Soapfilmlogy. **(6)**

**Unit- 6**

**Energy Methods:**

Concept of elastic strain energy, Strain energy due to axial force, shear force, torsion, bending moment, Principle of superposition, Maxwell-Betti-Rayleigh reciprocal theorem, Castigliano's theorems, Principle ofvirtualwork. **(8)**

**Term Work:**

Minimum six assignments based on the above topics including two exercises involving analysis (Analytical or FEA) and design modification for a component.

**Text Books:**


1) S. P. Timoshenko and J N Goodier, "**Theory of Elasticity**", McGraw Hill BookCompany.
2) L. S. Srinath, "**Advanced Mechanics of Solids**", Tata McGraw Hill BookCompany.

3) Richard G Budynas, "**Advanced Strength and Applied Stress Analysis",** McGraw Hill , New Delhi, Second Edition,2011.

**Reference Books:**

1) Sadhusingh, "Theory of Elasticity", Khanna Publishers, New Delhi, Fourth Edition,2012.
2) Wang C. T. , "Applied Elasticity", McGraw Hill, New Delhi,1990.
3) L. D. Landau and E. M. Lifshitz, "Theory of Elasticity", Vikas Publishing House Pvt. Ltd, New Delhi.
4) T. G. Sitharam, "Applied Elasticity", InterlinePublishing.
5) Phillips, Durelli and Tsao, "Analysis of Stress and Strain" McGraw Hill BookCompany.

**Final Year B. Tech (Production Engineering) –Semester VIII**

**ELECTIVE – II: 3. ADVANCED TOOL & DIE DESIGN**

**Course Code: PCE-PE411**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective:**

To study principles of designing fixtures and dies for industrial applications.

**Corse Outcome:**

The students shall have the knowledge of the principles of designing fixtures and dies for industrial applications.

**Unit-1**

**Introduction:** Jigs and Fixtures, Flexible Fixture, Materials for Tools, Fixture and Dies**.. Modular Fixture Systems**: Development of modular fixtures, T- slot based and Dowel pin based Modular Fixture systems, Interactive Computer Aided Fixture Design (I-CAFD) Structure, Locating / clamping Model Analysis and classification, Fixture Component Selection, Fixture component Assembly Manipulation.**(9)**

**Unit-2**

**Group Technology based Computer Aided Fixture Design:** Fixture Design process analysis, Fixture Structure Analysis, Fixture Feature Analysis, Fixture Design Similarity Analysis, Representation of Fixture, Feature information, Automated Fixture configuration Design. **(6)**

**Unit-3**

**Geometric and Accuracy Analysis:** Geometric constraint conditions, Assembly Analysis, 3-D Fixture configurations, Locating Accuracy and Error analysis, clamp planning, Machining accuracy analysis.**(5)**

**Unit-4**

**Basic Principles of Metal Forming:** Flow conditions and flow curve, Deformation and material flow, force and work, Formability.**Die Design for Hydro Forming:** Process Technology, Die design considerations, die layout, die-clamping,lubricants. **(8)**

**Unit-5**

**Die Design for Deep Drawing and Stretch Drawing:** Design considerations, die materials, efforts of friction, wear and lubrication, Die handling, Die clamping, dies for hydro mechanical deep drawing.**(5)**

**Unit-6**

**Extrusion Dies:** Die Design for metal and plastic extrusion, die materials, die clamping, die handling, Dies for Solid Sections, Dies for hollow section. **(7)**

**Term Work:**

The term work shall consist of all of the following assignments.

1) Case Study of T- Slot based Modular Fixturesystem.
2) Case Study of Dowel pin based Modular Fixturesystem.
3) Computer Aided Fixture Design for SimpleComponent.
4) Die Design for stretch drawing operation for acomponent.
5) Extrusion die design for solid section inplastic.
6) Study of die clamping systems for variousprocesses.

**Reference Books:**


1) Rong, Yeming; "Computer Aided Fixture Design", Marcel Dekker, ISBN0-8247-9961-5
2) Metal Forming Handbook – Schuler, Springer- VerlagBerlin.
3) Dies for Plastic Extrusion – M.V. Joshi – McMillan.
4) Tool Design – C. Donaldson, LeCain&Goold(TMH)
5) Tool Design – H.W. Pollack(Taraporwalla)
6) ASM Handbook – Forming –ASME
7) Handbook of Die Design, 2/e – Suchy, I (McGraw Hill),2006.
8) Design of Jigs and Fixtures – Hoffman(Pearson)
9) An Introduction to Jig & Tool Design, M.H.A. Kempster,(ELBS)
10) Jigs and Fixture Design Manual, Henrikson (Industrial Press,NY)
11) Die Design Fundamentals, J. R. Paquin, R. E. Crowley, Industrial PressInc.
12) Jigs & Fixtures; Design Manual – (2/e), P.H. Joshi, (TMH)(2003)

**Final Year B. Tech (Production Engineering) –Semester VIII**

**ELECTIVE – II: 4. MATERIAL HANDLING SYSTEMS**

**Course Code: PCE-PE411**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective**

To study material handling equipments their selection, design concepts and applications.

**Course Outcome:**

The students shall have the knowledge of material handling equipments their selection, design concepts and applications.

**Unit-1**

**Introduction**: Definition, scope, basic concepts, principles of material handling, economics of handling, Concepts of unit load, containerization and palletization. **Facilities Design Function:** Scope, objectives and types; relationship of plant layouts with material handling, factors to be considered for plant layout design; Space planning for various activities like office, storage, and production etc., factors - area allocation, location, relative positions,futureexpansion. **(10)**

**Unit-2**

**Material Flow**: Operation sequence, material flow pattern, Part flow analysis in group technology, stages of material flow - at receiving, in process and at shipping, flow planning criteria and design of flow pattern. **(5)**

**Unit-3**

**Warehousing:** Concept, Types, Storage and design considerations forin-housewarehouses. **(2)**

**Unit-4**

**Equipment for Material Handling Systems for Various Materials:**

**a)** Storing equipments like pallets, bins, racks, decking, order picking,positioningequipments.**(4)**

**b)** Hoisting equipment like jacks, pulleys, hand trolleys, hoists, power hoist, various types of cranes and elevators. **(3)**

**c)** Equipment for Material Movement: i) Conveyingequipments like belt, chain, roller, wheel, trolley, tray conveyors, gravity and vibratory type conveyors,screwconveyors. **(3)**

ii) Mobile equipment like hand trucks, fork lift trucks, powered industrial trucks and tractors, powered stackers, reach trucks,orderpickers. **(3)**

**Unit-5**

**Design and Selection of M. H. Equipment:** Factors affecting, procedure for selection, design of conveyor, electric hoist,casestudies **(4)**

**Unit-6**

**Automated Material Handling:** Need, Comparison with conventional systems, equipments like industrial robots and automatically guided vehicles, ASRS, use of simulation software for design of m. h. system.

**Safety and Training:** Need, environmental and human factors in material handling.**(5)**

**Term Work:**

Assignments Sr. no. 1 to 4 shall consist of the industrial case studies.

1. Study of Facilitydesign
2. Study of Material flowanalysis
3. Study of Storing and hoisting equipments
4. Study of Conveying and mobileequipments
5. Selection of M.H. equipments and design of conveyor/electrichoist.
6. Exercise on design / simulation of M.H.S. using simulation software like FLEXSIM orsimilar
7. Industrial visit to study material handling practices and itsreport

**Reference Books:**


1. Material Handling - Immer J. R. (McGrawHill)
2. Plant Layout & Material Handling - James Apple (JohnWiley)
3. Material Handling System Design - James Apple ((JohnWiley)
4. Material Handling Principles & Practice - Theodore H. Allegre Sr. (CBS Publishers & Distributors)
5. Facilities Planning – 3/e, Tompkins, White, Bozer, Tanchoco (John Wiley &Sons)
6. Material HandlingHandbooks
7. Work Study - O. P. Khanna (Dhanpatrai&Sons)

**Final YearProduction Engineering) Part-II, Semester VIII**

**Elective-II: 5. ARTIFICIAL INTELLIGENECE**

**Course Code: PCE-PE411**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Corse Objective:**

To understand the fundamental concepts of Artificial Intelligence and its applications.

**Course Outcome:**

The students shall demonstrate the knowledge of the fundamental concepts of Artificial Intelligence and its applications.

**Unit-1**

**Introduction: Concept of AI, approaches** – acting and thinking like humans and rationally, brief history of A.I, foundations of A.I, underlying assumptions,applicationareas. **(3)Pro**

**blem formulation:** Problem solving agents, components of problem definition, defining the problem as state space approach, Problem characteristics, Production system, searching for solutions,Forward& Backward reasoning, means end analysis, Graphs and Trees, measuring problem solvingperformance.**(4)**

**Unit - 2**

**Search Strategies:** a) Uninformed (blind) search – breadth first, depth first and their variations, avoiding repeated states b) Informed (Heuristic) Search – evaluation /heuristic function, generate and Test, Best first search, A* search, Local search algorithms – Hill climbing, simulated annealing, local beam search, Branch & Bound search, GeneticAlgorithms,terminology. **(5)**

**Unit - 3**

**Knowledge Representation:** Simple relational knowledge, Inheritable knowledge, Inferential knowledge, Procedural knowledge, the frame problem, Propositional Logic–Syntax and semantics, properties of statements, Inference rules, First Order Predicate Logic: syntax and semantics, well formed formulas (WFF), Properties of WFFs, conversion to clausal form, using FOPL, inference rules, unification, non-deductive inference methods, resolution, forward and backward chaining, the knowledge engineering process. Handling uncertain knowledge, probability propositions, atomic events, un-conditional (prior) and conditional (posterior) priority, Bayes rules and its use, Bayesian network and its semantics, inference inBayesiannetworks. **(7)**

**Unit - 4**

**Learning:** Forms of learning, inductive learning, decision trees learning, ensemble learning, pattern recognition: introduction, recognition and classification process, learning classification patterns. **(4)Knowledge Based Systems:** Expert systems, components, characteristic features of expert systems, applications, rule based system architecture, representing and using domain knowledge, expert system shell, explaining the reasoning and knowledgeacquisition,applications. **(6)**

**Unit - 5**

**A.I. in Robotics:** State space search, Block word and robot example, path selection, Monkey and Banana problem, AND – OR graph, means end analysis in a robotic problem, robot problem solving as a production system, triangle table, robot learning, robot task planning, phases in task planning, symbolic spatial relationships, obstacle avoidance,graphplanning. **(6)**

**Unit - 6**

**Machine Vision:** Introduction, functions in a vision system, imaging devices, lighting, A-D conversion, quantization, encoding image storage, image data reduction, segmentation techniques, feature extraction, object recognition, training the vision system, robotic applications ofmachinevision. **(5)**

**Term Work:**

The term work shall consist of the following.

1. Minimum Six programming exercises using a suitable language (e.g. PROLOG, LISP, C++ etc.) preferably in manufacturing relatedarea.
2. One case study on application of A.I. & E.S. in Manufacturing Engineering/Management.

**Reference Books:**

1. Artificial Intelligence: A Modern Approach- 2 /e (2003) Stuart Russel, Peter Norvig (Pearson Education).

2. Artificial Intelligence: 2/e (1991)- Elaine Rich, Kevin Knight(TMH).
3. Introduction to Artificial Intelligence & Expert Systems – Dan W.Patterson.(Seventh Indian Reprint 1999) (EEE) (PHI).
4. Handbook of Expert Systems in Manufacturing – Rex Mauss, Jessica Keyes (McGrawHill).
5. Industrial Robotics – Technology, Programming and Applications - Groover, Weiss, Nagel, Odrey, (McGrawHill).
6. Robotics: Control, Sensing, Vision and Intelligence – Fu, Gonzalez and Lee. (McGrawHill).
7. Conference Proceedings & Current Journals for case studies andapplications.

**Final YearB. Tech. (Production Engineering) Part-II, Semester VIII**

**Elective-II: 6. INDUSTRIAL ROBOTICS**

**Course Code: PCE-PE411**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective:**

To study fundamentals, analysis, applications and programming for industrial robots.

**Course Outcome:**

The students shall have the knowledge of fundamentals, analysis, applications and programming of industrial robots.

**Unit-1**

**Introduction:** Automation and Robotic System, Anatomy and work volumes, Classification. **Drives & Control System:** Hydraulic and pneumatic actuators, electrical drives for robotics, control loops, basic control system concepts and models, control system analysis, robot activation & feedback components, position and velocity sensors, powertransmissionsystem. **(6)**

**Unit-2**

**a) Robot & Peripherals:** End effecters – types, mechanical electromagnetic, pneumatic grippers, tool as end effecter, robot end effecter interface. Sensors – sensors in robotics, tactile sensors, proximity and range sensors, sensor based systems anduses.

**b) Machine Vision-** Introduction, low level and high level vision, sensing and digitizing, image processing and analysis, segmentation, edge detection, object description and recognition, interpretation, applications. **(8)**

**Unit-3**

**Programming for Robots:** Methods, robot program as a path in space, motion interpolation, characteristics of robot level and task level languages, robot languages, programming in suitable languages, Simulation ofrobotprograms. **(6)**

**Unit-4**

**Robot Kinematics:** Introduction, forward, reverse & homogeneous transformations, manipulator path control, introduction to robot dynamics configuration of arobot controller. **(6)**

**Unit-5**

**Robot Intelligence and Task Planning**: Introduction, state space search, problem reduction, use of predictive logic, means – ends analysis, problem solving, robot learning, robottaskplanning. **(6)**

**Unit-6**

**Robotic Applications:** Applications in manufacturing -material transfer, machine loading and unloading, processing operations, assembly and inspections, robotic cell design and control, applications in other areas: toxic, hazardous and inaccessible, service industry. **Social Issues-** safety and economics in robotics. **(8)**

**Term Work:**

Minimum Six exercises from following.

1) Two Programming exercises forrobots.
2) Three case studies of applications in industry involving working out the scheme with typeof
3) Robots, other accessories with sequence andlogic.
4) Three exercises using a suitable robotic simulation software for handlingapplications.

**Reference Books:**


1) Industrial Robotics: Technology, Programming & Applications- Groover, Weiss, Nagel, Ordey McGrawHill
2) Robotics: Control, Sensing, Vision & Intelligence. - Fu, Gonzalez, Lee (McGrawHill)
3) Robotics Technology & Flexible Automation – S.R. Deb(TMH)
4) Handbook of Industrial Robotics – Ed. Shimon Y. Nof (JohnWiley.)
5) Fundamental of Robotics, Analysis & Control – Robert J. Schilling(PHI)
6) Robotics for Engineers – YoramKoren (McGrawHill)
7) Introduction to Robotics: Analysis, Systems & Applications – Saeed B. Niku (PearsonEducation)
8) Keramas, James G. (1998), " Robot Technology Fundamentals", ISBN: 981-240-621-2 (CENGAGE)

**Final YearB. Tech. (Production Engineering) –Part-II, Semester VIII**

**ELECTIVE-II: 7. COMPUTER INTEGRATED MANUFACTURING SYSTEMS**

**Course Code: PCE-PE411**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective:**

To understand the concepts of computer integrated manufacturing system and its applications.

**Course Outcome:**

The student shall demonstrate the knowledge of the concepts of computer integrated manufacturing system and its applications.

**Unit-1**

**Basic Concept of CIMS,:-**Scope, islands of automation, architecture of CIM, information flow in CIM, elements of CIM, benefits, limitations, obstacles in implementation Planning for CIMS, need for planning, Phases of CIM implementation, incremental implementation and one timeimplementation,CIM benchmarking, Economic and social justificationofCIM. **(6)**

**Unit-2**

Product Design and CAD, application of computers in design, CAM – manufacturing planning and control, scope of CAD / CAM and CIM, Concurrent engineering, Design for manufacturing and assembly ,Case studies on Concurrent engineering, Design for manufacturingandassembly. **(6)**

**Unit-3**

**a) Group Technology:** Concept, design and manufacturing attributes, part families, composite part, methods of grouping, PFA, classification and coding system- OPITZ, Relevance of GT in CIM, GT and CAD, benefits and limitationsof GT. **(3)**

**b) Computer Aided Process Planning and Control:** need, retrieval and generative type CAPP, role of CAPPinCIM. **(2)**

**c) Computer Aided Production Planning and Control:** Computer integrated production management system, Role of computers in aggregate planning, master production schedule, shop floor control, materials requirement planning, and capacity planning, manufacturing resource planning and enterprise resourceplanning **(3)**

**Unit-4**

**Flexible Manufacturing Systems, Transfer lines, Assembly Lines in CIMS:** Concept, flexible & rigid manufacturing, manufacturing cell and FMS structure, types, components of FMS, Distributed Numerical Control (DNC), Building Blocks of FMS, Flexible Assembly System, Transfer Lines, concept, applications, benefits, Automates assembly lines, Designforassembly. **(6)**

**Unit-5**

**Production Support Machines and Systems in CIM: Robots, types, joint configurations,** Industrial robots for load/unload, automated material handling, automatic guided vehicles, Types, Vehicle guidance, Management and safety, automated storage andretrievalsystem. **(6)**

**Unit-6**

**a) Data Acquisition and Database Management Systems:** (a) Data acquisition system, type of data, automatic data identification methods, bar code technology, machine vision.(b) Data and database management system, database design requirements, types of DBMS models- hierarchical, network and relational models andtheirapplications **(4)**

**b) Communication in CIMS:** Role of communication in CIMS, requirements of shop floor communication, types and components of communication systems in CIM, Networking concepts, network topology, access methods, ISO-OSI reference model for protocols, MAP/TOP, TCP/IP.**(4)**

**Term work:**

1) Exercise on classification and coding of components using GT Techniques, related toa) Design Attributes, b) Manufacturingattributes.
2) Exercise on building MRP system for a company manufacturing approximately 3–5assembly products involving total about 15components.
3) Exercise on capacity planning for a turning shop with 5 – 10 lathes, 15 turnedcomponents with average 3 to 4 turning operations each, for given batchsizes.
4) Study of co-ordinate measuring machine involving study of dimensions andgeometrical features of components, accessories of C.M.M.s and programming aspects,through an industrial visit and itsreport.

5) Exercise on Database Management- Creation of a simple manufacturing database usingMS Access or similar software involving query,sorting.
6) Case study on data acquisition systems, LAN structure & communicationinterface.

**Reference Books:**


1) Automation, Production systems and Computer Integrated Manufacturing, 3/e - M.PGroover (PHI or PearsonEducation)
2) Computer Integrated Design and Manufacturing - Bedworth, Henderson & Wolfe,(McGrawHill)
3) Performance Modeling of Automated Manufacturing Systems, 2/e- Viswanadham,N&Narahari, Y. (EEE) (PHI)
4) Principles of Computer Integrated Manufacturing - S. Kant Vajpayee,(PHI)
5) CAD / CAM Principles and Applications - P.N. Rao (Tata McGrawHill)
6) CIM Handbook - Teicholtz& Orr (McGrawHill)
7) CAD/CAM/CIM, 3/e – Radhakrishnan, Subramanayam&Raju (New AgeInternational)
8) Computer Integrated Manufacturing, 2/e - James A. Rehg, H. W. Kraebber,(PearsonEducation).
9) MAP/TOP Networking : Foundation of CIM – Vincent Jones (McGrawHill)

**Final YearB. Tech. (Production Engineering)Part-II, Semester VIII**
**Elective-III: 1. MARKETING MANAGEMENT**
**Course Code: PCE-PE412**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective:**

Study of fundamentals of marketing and its commercial and technical application.

**Corse Outcomes:**

The students shall be able to demonstrate the knowledge of fundamentals of marketing and its commercial and technical application

**Unit-1**

**Introduction:** Meaning, scope, needs and importance of marketing, difference between marketing and selling, concept of market, types of markets, marketing concepts and tools, concept of societal marketing, marketing strategies, impact of Multi National Corporations, privatization etc. E-commerce/ on line marketing. **(5)**

**Unit-2**

**Buying Behavior of Organizational and Consumer Buyers:** Factors influencing buying process analysisofbehavior. **(3)**

**Marketing Planning:** Meaning and importance, marketing strategies, sales forecasting, methods of sales forecasting, marketing budget and marketing organization, databanksutilization **(3)Mark**

**et Segmentation**: Meaning, bases for segmenting consumer markets, market coverage strategies adopted for segmenting the market, aggregation strategy, single segment strategy and multiple segment strategy. **(3)**

**Unit-3**

**Marketing Information systems [MIS]:** Marketing research marketing research procedure, the order – shipping - billing cycle, the system of sales reporting,computer integration. **(5)**

**Unit-4**

**I) Marketing Mix**: Introduction to marketing Mix elements - product, place, promotion andrice

**a]** Product [Goods and Services]: Concept of product, classification of consumer goods, convenience goods, shopping goods and specialty goods, product life cycle, product mix, product decisions to be made such as brand policy decisions, product modification decisions, product elimination decisions, new product development decisions and product mix decisions, procedure for new productdevelopment.

**b]** Place: Channels of distribution, meaning, types of channels, selecting the type of a channel, channel management, physical distribution wholesaling andretailing.

**c]** Promotion: An introduction to promotion-mix elements, advertising, personal selling, sales promotion andpublicity

**d]** Pricing:Meaningandimportanceofprice,pricingobjectives,procedureforsettingthebaseprice,price modification andpricenegotiation **(8)**

**II) Advertising**: Objectives, types of advertisements, developing advertising campaign, deciding on advertising media, sales promotion and publicity, ethics, regulationsforadvertising. **(2)**

**Unit-5**

**Sales Management**: Meaning and its role in marketing function responsibilities of sales department, personal selling, sales force, designing a sales force, recruiting and selecting a sales force, training and remuneration of sales force, sales territories, sales quotas, performance evaluation of sales staff, salesmanship **(4)**

**Ubit-6**

**Industrial Marketing**: MNCs, other major participants, cultural environment, attitudes, practices, ethics, monetary system; Export marketing – need, information, databaseandlegislation **(3)**

**Term Work:**

Any five exercises to be conducted based on topics below (Sr. No. 6 compulsory).

1. Survey ofBuyers.
    - Questionnaire Preparation – product /service
    - Obtaining thefeedback
    - Analysis

2. Case study based on selection of product / service and its technical study from various competitors availablenearby.
3. Development of market segmentation strategy for a product of acompany.
4. New product development based on survey of 10-15 potentialbuyers.
5. Case study based on (anyone)
    - Distribution network of acompany
    - Developing an advertising campaign for aproduct.
6. Group discussion on any one of the above topic (Each group of about 8students).

**Reference Books:**


1. Kotler, Armstrong, "Principles of Marketing", 10/e, PearsonEducation
2. Philip Kotler, "Marketing Management", Prentice-Hall ofIndia.
3. J.C.Gandhi, "Marketing- A Managerial Introduction",TMH
4. David Luck et al, "Marketing Research",TMH
5. Mahendra Mohan, "Advertising Management"TMH.
6. James S. Norris, "Advertising", Prentice-Hall ofIndia.
7. B. Horvard Levy, " Marketing made simple", Rupa Paperback on BusinessManagement
8. J.C.Gandhi, " Principles of Marketing andSalesmanship"
9. Hill," Industrial Marketing"

**Final YearB. Tech. (Production Engineering) Part-II, Semester VIII**

**Elective-III: 2. STATISTICS FOR ENGINEERING RESEARCH**
**Course Code: PCE-PE412**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective:**

To study the fundamental concepts and methodology of statistics with reference to its application in engineering research.

**Course Outcome:**

The students shall have the knowledge of fundamental concepts and methodology of statistics with reference to its application in engineering research.

**Unit-1**

**Research Methodology:** Introduction. The Design of Research, Meaning, Need, Dimensions and Process, Types of research design, Hypothesis Testing: Sampling theory; Formulation of Hypotheses, Sampling Techniques- Simple random sampling, systematic, Stratified, Multistage, Cluster sampling, Designing and Methodology of an experiment. Introduction: Measures of Location: Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode and simple properties. Measures ofDispersion-Range, Quartile Deviation, Mean Deviation, Variance, Standard Deviation, CoefficientofVariation. (6)

**Unit-2**

**Probability:** Statistical Probability with simple problems. Conditional probability.Baye's Theorem.**(5)**

**Unit-3**

**Test of Significance:** Sampling distribution of mean and standard error, Large sample tests- Z-Test for an assumed mean and equality of two population means, Small sample tests, t-test for an assumed mean and equality of means of two populations, Paired t-test. Confidence Intervalformeans. **(8)**

**Unit-4**

**Correlation and Regression:** Bi-variate data, Simple correlation and Regression coefficients and their relation. Linear regression and equations of line of regression.CurveFitting. **(5)**

**Unit-5**

**Test using Chi-square Distribution:** Inference about population variance (F test). Goodness of fit test. Test for independence of attributes Yates's Correction. Confidence Intervalforvariances. **(5)**

**Unit-6**

**Experimental Design:** Principles of experimental designs, completely randomized design. Randomized block design and precision of results. Simple factorial Experiments of $2^2$, $2^3$. Analysis of variance (ANOVA) and its uses inthedesigns. **(8)**

**Term Work:**

Total Six assignments based on each of the six units of the above syllabus, including quantitative assignments on data analysis, hypothesis testing, and analysis of variance using suitable statistical analysissoftware.

**Reference Books:**


1) Fundamentals of Mathematical Statistics - Gupta V.K. &KapoorS.C..- S. ChandPublicatons.
2) Design and Analysis of Experiments, Montgomery, D.C.: Wiley Eastern Ltd., NewDelhi.
3) Statistical Methods, S P Gupta, Sultan Chand & Sons, Latestedn
4) Statistics for Management- T. N. Srivastava, SailajaRego, Tata McGraw HillPublications.
5) Fundamentals of Business Statistics, 2nd Edition, J. K. Sharma, Vikas Publication,2014.
6) Research Methodology- Methods and Techniques, Kothari, C.K., (2004), 2/e, (NewAge International, NewDelhi)
7) Research Methodology, Panneerselvam, PHI, ISBN:81-203-2452-8

## Elective-III: 3. MATERIALS MANAGEMENT

### Course Code: PCE-PE412

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective:**

Study of fundamental concepts and applications of various techniques of Materials Management in practice.

**Course Outcomes:**

The students shall have the knowledge of various concepts and application of different techniques of materials management.

**Unit-1**

**Introduction:** integrated materials management concept. Objectives, organizational structure, material cycle, Make or Buy Decision- factors, financial andmanufacturingaspects **(4)**

**Unit-2**

**Materials Forecasting**: general economic forecast, major cyclical indicators, forecasting the price, materials requirement planning.(MRP) Purchasing- Functions, Procedures, Documents used as per ISO 9001, Policies, Types of purchasing - hand to mouth, forward buying, speculative buying, commodity markets, price -costanalysis,negotiations **(8)**

**Unit-3**

Selection of sources of supply, Vendor evaluation and rating, Vendor development. Purchase research**,** value analysis, introduction to legal aspectsofpurchasing. **(7)**

**Unit-4**

**Inventory Management:** Basic concepts, Need, Deterministic and Probabilistic EOQ models, Inventory costs, Selective Inventory control techniques- ABC and VED analysis, Fixed quantity, Periodic review system, Spare Parts Inventory Management, safetystockdetermination **(7)**

**Unit-5**

**Stores Management:** Objectives, stores layout, storage system and equipment, automated storage and retrieval system, Procedures & Documents as per ISO9001, material classification and codification as per ISO 9001, materialsaccountingsystem. **(6)**

**Unit-6**

**Recent Trends in Inventory Management**: Zero inventory, JIT concept and tools, Management performance evaluation, information systems and computers applications in materials management, ERP moduleof MM. **(4)**

**Term Work:**

The term work shall consist of any six assignments based on following topics. (At least one exercise based on computers)

1. Case study on Make or Buydecision
2. Study of Material cycle, documents as per ISO / QS9000.
3. Case study on VendorRating
4. Case study on fixed period orders and fixed quantity inventory system with safety stock analysis
5. Exercise on MRP for a system with 2 to 3 product assemblies, each having aboutfive components
6. Exercises on probabilistic EOQmodels
7. Study of materials classification andcodification

**Reference Books:**


1. Materials Management - Dean S. Ammer (Taraporwalla&Sons)
2. Purchasing Management- J.H. Westing, I.V. Fine C.J. Zenc (John Wiley andSons)
3. Purchasing & Materials Management - Lamer Lee Jr... Donad W. Dobler(TMH)
4. Integrated Materials Management- A. K. Dutta (S. Chand &Co.)
5. Stores House and Stock management - H. K. Comption (Business BooksLtd.)
6. Storage Controls & Stocks - Alex Morrison(ELBS)
7. Purchasing and Materials Management- P. Gopalkrishnan(TMH)
8. Materials Management - A. K. Dutta(PHI)
9. Stores Management – K.S.Menon(MACMILLAN).

**Final YearB. Tech. (Production Engineering) Pat-II, Semester VIII**

**Elective-III: 4. PROJECT MANAGEMENT**

**Course Code: PCE-PE412**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective:**

To study the fundamental concepts, tools and techniques of Project Management & its applications.

**Course Outcome:**

The students shall demonstrate the knowledge of the fundamental concepts, tools and techniques of Project Management & its applications.

**Unit-1**

**Introduction to Project:**

Definition of a Project, Types, Sequence of Activities, Unique activities, Complex Activities, Connected Activities, One Goal, Specified Time, Within Budget, According to Specification. Defining a Program, Project parameters: Scope, Quality, Cost, Time, Resources; The scope triangle: Time, Cost, and Resource Availability,ProjectClassification. **(3)**

**Unit -2**

**Project Management:**

Principles of Project Management: Defining, Planning, Executing, Controlling, Closing; Project Management Life Cycle: Phases of Project Management, Levels of Project Management; Quality Management: Continuous Quality Management Model, Process Quality Management Model; Risk Management, Risk Analysis; Relationship between Project Management and other Methodologies.**(6)**

**Unit-3**

**Project Activities:**

Work Breakdown Structure, Uses of WBS, Generating the WBS: Top-Down/ Bottom-Up Approach, WBS for Small Projects, Intermediate WBS for large projects; Criteria to Test for Completeness in the WBS: Measurable Status, Bounded, Deliverable, Cost/Time Estimate, Acceptable Duration Limits, Activity Independence; Approaches to Building the WBS: various approaches, Representing WBS. **Activity Duration, Resource Requirements, & Cost:** Duration: Resource Loading versus Activity Duration, Variation in Activity Duration, Methods for Estimating Activity Duration, Estimation Precision; Resources; Estimating Cost, JPP Session to Estimate Activity Duration & Resource Requirements, DeterminingResourceRequirements. **(8)**

**Unit-4**

**Fundamentals of Project Network Diagram:**

Project Network Diagram, Benefits to Network- Based Scheduling, Building the Network Diagram Using the PDM, Analyzing the Initial Project Network Diagram.**(5)**

**Network Analysis – PERT:**

Introduction to Project Evaluation and Review Technique, Event, Activity, Dummy, Network rules, Graphical guidelines for network, Common partial situations in network, numbering the events, Cycles; Developing the Network, Planning for network construction, modes of network construction, steps in developing network, hierarchies; Time Estimates in PERT, Uncertainties and use of PERT, Time estimates, Frequency distribution, Mean, Variance & standard deviation, Probability distribution, Beta distribution, Expected time; Time Computations in PERT, Earliest expected time, Formulation for TE,Latest allowable occurrence time, Formulation for TL, Combined tabular computations for TE, TL; Slack, Critical Path, Probability of meetingscheduledate. **(9)**

**Unit-5**

**Network Analysis- CPM:**

Introduction to Critical Path Method, Procedure, Networks, Activity time estimate, Earliest event time, Latest allowable occurrence time, Combined tabular computations for TE and TL, Start & Finish times of activity, Float, Critical activities & Critical path. Crashing of project network, Resource leveling and Resourceallocation. **(8)**

**Unit-6**

**Schedules Based on Resource Availability:**

Resources, Leveling Resources, Acceptability Leveled Schedule, Resource Leveling Strategies, Work Packages: Purpose of a Work Package, Format of aWorkPackage. **(6)**

**Term Work:**

Term work shall consist of at least six assignments based on above units. At least one assignment shall be based on computer application for project management using suitable software.

**References Books:**


**1)** Prasanna Chandra, "Projects – Planning, Analysis, Financing, Implementation and Review", Tata McGraw Hill,4th Ed,1997

**2)** Mike Field and Laurie Keller, "Project Management", Thompson Business press,2002

**3)** Gido and Clements, "Successful project management", 2nd edition; Thompson south-western,2003

**4)** John M Nicholas, "Project Management for business and technology", 2nd edition, Pearson Education Asia,2001

**5)** Bhavesh M Patel, "Project Management – Strategic Financial planning, Evaluation and control", Vikas publishing house,2000

**6)** S.Choudry "Project Management", Tata McGraw Hill,27th edition,2006

**7)** Effective Project Management Robert K. Wysocki, Robert Beck. Jr., and David B. Crane; - John Wiley &Sons.

**8)** Project Planning and Control with CPM and PERT- Dr. B.C. Punamia&K.K.Khandelwal; - Laxmi Publications, NewDelhi.

**9)** Project Management- S. Choudhury, - TMH Publishing Co. Ltd, NewDelhi

**10)** Total Project Management- The Indian Context- P. K. Joy, - Macmillan India Ltd.,Delhi

**11)** Project Management in Manufacturing and High Technology Operations- AdedejiBodundeBadiru, - John Wiley andSons.

**12)** Course in PERT & CPM- R.C.Gupta, - DhanpatRai and Sons, NewDelhi

**Final YearB. Tech. (Production Engineering) Part-II, Semester VIII**

**Elective-III: 5. FINANCIAL MANAGEMENT**

**Course Code: PCE-PE412**

| **TeachingScheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs) | |
| Practical: 2Hrs./Week/Batch | ESE: 70 Marks |
| Credits: 4 | CIE: 30Marks |
| | Term Work: 25Marks |

**Course Objective**:

To study the basic concepts of financial management applied to manufacturing industry.

**Course Outcome:**

The students shall be able to demonstrate the knowledge of financial management as applied in the manufacturing industry.

**Unit-1**

**Finance Function and Sources of Finance: -** Objectives of Financial management, finance Functions, Internal and External, Short, medium, and longtermfinance **(6)**

**Unit-2**

**Management Accounting:** Types of financial statements, Interpretation of financial statements using Ratio Analysis, cost volume profit analysis, Workingcapitalmanagement. **(8)**

**Unit-3**

**Financial structure, cost and financing decisions: -** Planning capital structure, Debt – Equity Ratio and financing, cost of capital, concept of operating and financial leverage, capital budgeting – Nature and significance .Techniques ofcapitalbudgeting. **(6)**

**Unit-4**

**Project Planning: -** Generation and screening of project ideas market and demand analysis, technical analysis financial estimatesandprojection. **(4)**

**Unit-5**

**Marketing of Securities and Dividend Policies:** - Underwriting, role of stock exchange, functions, operations, government regulations of stock exchanges in India, Issue of bonus shares, Right issue, Dividend policies, determinants of dividend policies, concept ofportfolioanalysis.**(8)**

**Unit-6**

**Budgeting and budgetary control:** Meaning of budget, budgetary control, budgeting, essentials of effective budgeting, advantages and limitations, classification, flexible budget, cash budget, sales budget.**(8)**

**Note: - Numerical Treatment is expected for the following topics:**

1. RatioAnalysis.
2. Cost volume profitanalysis
3. Capital Budgeting
4. Cost ofCapital
5. WorkingCapital
6. Budgeting: a) Flexible Budgeting b) Cash Budget c) SalesBudget

**Term Work:**

1. One assignment on Finance Function to be studied by visiting a local industrialorganization.
2. Numerical exercises on the areas mentionedabove
3. Two case studies on industrialfinancing

**Reference Books:**


1. Financial Management- I.M Pandey. Vikas Publishing House PvtLtd.
2. Management Accounting & Financial Management – R.K.Sharma&Shashi K. Gupta– Kalyani Publishers.
3. Project Planning, Analysis, Selection, Implementation & Review. - Prasanna Chandra-TataMac Grew Hill Publishers.
4. Financial Management- P.V. Konkani &B.G Sashay Prasad – Himalaya PublishingHouse.
5. Management Accounting- R S.N Pillai, Bagavathi – S.Chand& CompanyLtd.
6. Corporate Finance – S. C. Kuchhal&Suchitra Mittal (ChaitanyaPublicationHouse)
7. Financial, Cost and Management Accounting – Dr. P. Periasamy, Himalaya PublishingHouse.
8. Financial Management – Dr. P. Periasamy, HimalayaTMH.

**Final YearB. Tech. (Production Engineering) Part- II, Semester VIII**
**Elective-III: 6. ENTREPRENEURSHIP DEVELOPMENT**
**Course Code: PCE-PE412**

**TeachingScheme:**
Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs)
Practical: 2Hrs./Week/Batch
Credits: 4

**Examination Scheme:**
ESE: 70 Marks
CIE: 30Marks
Term Work: 25Marks

**Course Objective:**
To familiarize students with fundamentals of Entrepreneurship and to encourage them to become successful entrepreneurs.

**Course Outcomes:**
The students shall demonstrate the knowledge of Entrepreneurship and shall be motivated to become successful entrepreneurs.

**Unit - 1**
**Entrepreneurship:** Definition of Entrepreneur and Entrepreneurship, entrepreneurial process, Entrepreneurship and economic development, job creation, Indianscene.
**Entrepreneurial Motivation**: Self-disclosure, personality effectiveness, risk taking, entrepreneurial competencies,casestudies. **(3)**

**Unit - 2**
**Small Scale Units:** Concept and definition, role of S.S.I. in Indian economy, government policies and facilities.
**Planning Small Scale Business:** Business opportunity identification, idea generation, ideas from marketplace, market assessment, demand estimation.
**Small Business Management:** Techniques of marketing, materials, production, manpower and financial management, crisis management, working capital management, fixed capital assessment, cash flow analysis, ROI, techniques of decision making.
**Demand Analysis:** Demand Theory and Analysis – Individual demand and Market demand – Factors determining demand – Elasticity of demand – Price Elasticity - Income Elasticity – Cross Elasticity – Elasticity and Decision – making (Analytical problems). Demand estimation: Linear regression, Interpreting coefficients, Interpreting regression fit, Omitted variables, Log linear estimation. Consumers Equilibrium, Cardinal utility approach, Indifference curve approach, Theory of revealed preference, Consumersurplus **(8)**

**Unit - 3**

**Managerial Economics:** Introduction to Economics, Kinds of Economic Decisions, Significance and applicability of Managerial Economics in decision making, Role and responsibilities of Managerial Economics, Economic principles relevant to managerial decision making, Opportunity cost, Production possibility curve, Concept of increments and Margin, Discounting principle. (Numerical Problems)

**Business Accounting:** Study of Balance sheets, Profit and Loss statements. Need, format of Trading and Profit and Loss A/c., Items to be recorded on the Debit and Credit Side of Trading and Profit and Loss A/c, Preparation of Trading and Profit and Loss A/c. Need, format of Balance Sheet, identification of Accounts to be written on liabilities and Assets side, Preparation of Balance sheet. (Analytical Problems)

**(9)**

**Unit – 4**

**Government Support Organizations:**

The detailed study of the government support system for the entrepreneurship development.

a) Central Government

b) Stategovernment

c) Financial supportorganizations

**d)** Government schemesandprocedures **(6)**

**Unit - 5**

**Business plan preparation:** Meaning of business plan, project parameters, information sources of economical and technical knowhow, selection of location, identification of raw material, suppliers, plants/machinery, process, manpower and other inputs such as power,wateretc. Preparation of project report including the following aspects. Analytical calculations for decision making at each of the following shall beincluded.-

1) Selection ofproduct.

2) Process and plant and machineryselection.

3) Site selection and Plant Layoutplanning.

4) Financial viabilityanalysis.

5) Marketing and distribution ofgoods.

**6)** Study of probable reasonsoffailure. **(8)**

**Unit - 6**

**Statutory Requirements:** Factories Act 1948, Industrial disputes Act 1947, Indian Contract Act, Indian sales and Goods Act, Indian Partnership Act, Central Excise, Sales tax, Income Tax Act, Value Added Tax(VAT).

**Business Aspects:** Business ethics, export environment, procedure and documentation, venture capital financing, intellectual property act,patents,GATT. **(6)**

**Term Work:**

Minimum Six exercises / case studies based on the topics below. Assignment No. 2, 4 & 6 shall include the analytical problems.

1. Study of Government policies and procedures to startSSI.
2. Study of Calculations of working capitalrequirements.
3. Study of resources and procedures to get financialassistance.
4. Study of taxprocedures.
5. Study of exportprocedures.
6. Study & Preparation of project feasibility report for the manufacturing of aproduct.

**Reference Books:**


1. Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.
2. Handbook of NewEntrepreneurs
3. Management of Small Scale Industry - Vasant Desai (HimalayaPublication)
4. Entrepreneurship Playing to Win- Gordon Betty (Taraporwala&Co.)
5. Motivating Economic Achievement- David C. McClelland, David G.Winter
6. Industrial Maharashtra- Facts, Figures and Opportunities (M.I.D.C.Mumbai).
7. Project Planning & Entrepreneurship Development - T. R.Banga
8. Dynamics of Entrepreneurial Development & Management- Vasant Desai (Himalaya Publication)
9. S.S.I. and Entrepreneurship- Vasant Desai (HimalayaPublication)
10. Petersen and Lewis : Managerial Economics, 4/e, Pearson/PHI, 2002. 2. Managerial Economics, Ahuja. H.L, S. Chand, NewDelhi.
11. M.L. Trivedi: Managerial Economics, Tata Mc-Graw Hill, New Delhi2004.
12. PindyckRubinfeld& Mehta, “Micro Economics”,Pearson
13. Ramachandran, and Kakani, “How to Analyze Financial Statements”, Tata McGrawHill
14. Palat, Raghu, “How to Read Annual Reports and Balance Sheets”, JAICO PublishingHouse
15. Dash A.P., “Financial Wisdom – Finance for Non-Finance Executives”, Biztantra ISBN 978- 81-7722-378-1

**Final YearB. Tech. (Production Engineering) Part-II, Semester VIII**
**Elective-III: 7. SUPPLY CHAIN MANAGEMENT**

**Course Code: PCE-PE412**

**TeachingScheme:**
Lectures: 3 Hrs. / Week TheoryPaper(2.5Hrs)
Practical: 2Hrs./Week/Batch
Credits: 4

**Examination Scheme:**
ESE: 70 Marks
CIE: 30Marks
Term Work: 25 Marks

**Course Objective:**

To study the fundamentals and applications of various techniques of Supply Chain Management in practice.

**Course Outcome:**

The students shall have the knowledge of the fundamentals and applications of various techniques of Supply Chain Management in practice.

**Unit-1:**

**Introduction to Supply Chain Management:** Building a Strategic framework to Analyze Supply Chains: Understanding the supply chain, supply chain performance, Supply chain drivers &obstacles.**(5)**

**Unit-2:**

**Planning Demand & Supply in Supply Chains:** Demand forecasting in supply chain, aggregate planning in supply chain, planning demand & supply insupply chains.**(6)**

**Unit-3:**

**Planning & Managing Inventories in a Supply in Supply chains:** Managing economies of scale in a supply chain: cycle inventory, managing uncertainty in supply chain: safety inventory, determining optimal level ofproductavailability. **(6)**

**Unit-4:**

**Design consideration in Supply Chain:** Transportation, Network Design, & Information technology in a supply chain: Transportation in supply chain, facility decisions: network design in a supply chain, information technology in asupplychain.**(7)**

**Unit-5:**

**Supply Chain Coordination Logistics in SCM:** Coordinating in a Supply Chain & role of E-Business: Coordination in a supply chain, E- business & the supply chain.

**Logistics In Supply Chain Management: I**ntroduction, Strategy, Transportation Selection, Trade-off, Models for Transportation and Distribution, Third Party Logistics, Overview of Indian Infrastructure for Transportation.**(7)**

**Unit-6:**

**Financial consideration in Supply Chain:** Financial factors Influencing Supply Chain Decisions: Financial evaluation of supply chain decisions, the impact of financial factors on supply chain decisions, evaluating supply chain decisions using decision trees. **(6)**

**TermWork:**

Any six assignments based on the above syllabus (One from each unit)

**Text Books:**

1. Sunil Chopra & Peter Meindl, "Supply Chain Management: Strategy, Planning, & Operation", Addison Wesley Longman.

2. A. J. Vanweela, "Purchasing & Supply Chain Management"Cengage learning(Nov2004) ISBN 1844800245

**Reference Books:**

1. R.H. Ballou, "Supply Chain Management" Pearson[2007] ISBN 8131705846 B. E. Production Engineering – S / W - 2008 Proposed Syllabus Page 36 of42

2. Simchi-Levi, Kaminsky, "Designing and Managing the Supply Chain, Concepts Strategies and Case Studies", 2nd edition, Tata McGraw Hill, ISBN0-07-058666-7

3. R. Monczka, "Purchasing & Supply Chain Management" Cengage learning business Press.,ISBN 140801744X

**Final YearB. Tech. (Production Engineering) Part-II, Semester VIII**

**PROJECT WORK- Phase II**

**Course Code: PW-PE413**

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Practical: 4 Hrs. / Week/ Batch | Term work: 50 Marks |
| | Oral Examination: 75 Marks |

**Course Objective:**

To prepare the students to carry out a comprehensive study of any design or process or phenomenon, to encourage the process of independent creative thinking and working in groups and to expose them to industrial atmosphere of accountability.

**Course Outcomes:**

The students shall have the ability to carry out a comprehensive study of any design or process or phenomenon as well as independent creative thinking and working in groups with exposure to industrial atmosphere of accountability.

Term Work:

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The work started in Semester VII will be continued in the Semester VIII and the final submission of the report will be at the end of the Semester VIII.

**The project work may consist of-**

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing it.
4. Experimental verification of principles used in applications related to Production or Mechanical Engineering.
5. A combination of the above.

A synopsis of the selected project work (two to three pages typed on A4 size sheets) will be submitted and assessed by the Project Guide and one more faculty member appointed by the Department / concerned responsible official of the sponsoring industry (Co-guide).

The work to be completed in Semester VII shall include-

a) Problem Identification

b) Methodology / Design Documents

c) Activity planning for the time frame and **division of responsibility to each student**. An interim report of the work completed in Semester VII in the form of workbook /project diary and other relevant documents shall be submitted for the term work. The term work shall be assessed by the Guide and one more faculty member appointed by the Head of the Department. The assessment shall be based on a presentation of the work completed and submission of interim report.

The oral examination shall be based on the work planned and actually completed in Semester-VII.